CLEAN AIR STRATEGY: AN ENGO PERSPECTIVE ON THE SCIENCE-POLICY INTERFACE

Max K. Wallis[1]

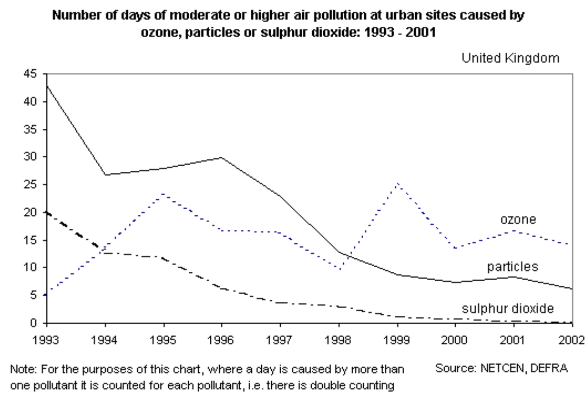
ABSTRACT

Environmental Non-Government Organisations (ENGOs) in Europe have been hardly involved in AIRNET, in part because the technicalities deter access. But ENGOs should be seen as representing the public as well as acting as stakeholders in their own right. They can be intimately involved in assessing the public information, as in the UK example criticised below. They can spotlight an issue like ultrafine particulate pollution that is being avoided for reasons of institutional inertia and special interests. For risk analysis and integrating a precautionary approach, ENGO participation within a stakeholder process is vital. Policies designed to combat air pollutants have to change profoundly how people live, travel and work (Maynard et al., 2003), yet policy-makers tend to duck the hard choices. Winning the public to make such changes requires enrolling the major campaigning ENGOs as allies, in the context of effective stakeholder communication and accountability in public information and policy setting.

[1] Cyfeillion y Ddaear, Wales UK

PUBLIC INFORMATION ON AIR POLLUTION

The UK uses "Headline Indicators" as an instrument of government - the indicator on air pollution (DEFRA, 2004) is supposed to inform the public of government performance on reducing pollution levels. It involves counting the number of days on which particles (PM_{10}) exceed the 50 $\mu g/m^3$ standard, or on which ozone exceeds 50 ppb for one or more hours in that day. The days on which one or more of PM_{10} or ozone (or sulphur dioxide) exceed these numbers are summed for each monitoring site and the average calculated over all UK national network sites. The results in Figure 1 show ozone and particles (PM_{10}) contribute, but sulphur dioxide hardly.



Note the 'particles' data are based on under-readings of PM_{10} by TEOM monitors, but this goes unmentioned.

Figure 1: Days of pollution exceedances, UK Urban sites.

Figure 2 shows that on this measure urban air is improving and that rural air is now worse than urban. This reflects the pattern of Figure 1 where ozone is currently assessed as worse than PM_{10}. However, giving equal weight to PM_{10} and ozone exceedances does not correspond to the actual harm (the ozone standard is for 8-hour not 1-hour average, while PM_{10} is now seen as many times more harmful than when the 50 $\mu g/m^3$ standard was set). Nitrogen oxides don't register, despite concerns over this urban traffic pollutant. Though scientifically unsound, the UK's Headline Indicator is retained for political expediency as it implies – wrongly – that the urban pollution problem is under control. The consequence has been public cynicism, bolstered by official excuses over the anomalous 2003 data. Secondly, air pollution dropped down the government's agenda and funding started to be cut back. The parliament's Public Accounts Committee (2002) questioned the spending, when air pollution modelling is very imprecise and there are considerable uncertainties and gaps in the evidence of the health effects of air pollution. The Committee required the government to address the most important gaps in its knowledge, such as which sizes of particles are the most dangerous, but this issue is still being ducked.

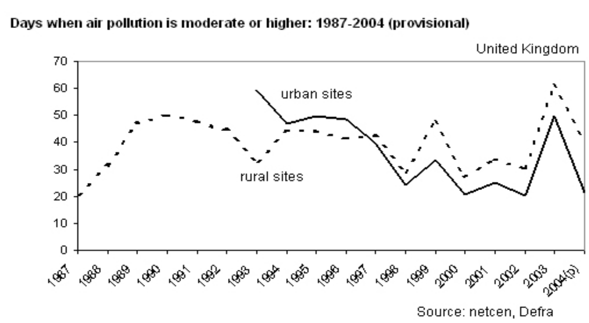


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Figure 2: Pollution exceedances, rural v. urban sites.

When Labour took over UK government in 1997, with healthy air as one of their priorities, they said they wanted straight talk. Instead of "air quality," we should talk of "air pollution." Instead of describing air quality as PM_{10} *very good*, PM_{10} *satisfactory* or PM_{10} *poor/very poor*, we now describe pollution levels as *Low, Moderate, High, Very high.*

These levels are defined numerically, but as Figure 3 shows (taken from DEFRA, 2002), they are described in relation to individual perception and likely symptoms. Maynard and Coster (1999) discuss more fully this banding system used for public information purposes.

numerical index /Pollution band	Health effect
1-3 **low**	Effects are unlikely to be noticed, even by people who know they are sensitive to air pollutants
4 - 6 **moderate**	Mild effects are unlikely to require action, but sensitive people may notice them
7 - 9 **high**	Sensitive people may notice significant effects, and may have to act to reduce or avoid them (for example, by reducing time spent outdoors). Asthmatics will find that their reliever inhaler should reverse the effects of pollution on their lungs
10 **very high**	The effects of high levels of pollution on sensitive people may worsen when pollution becomes very high
Sensitive individuals are people who suffer from heart and lung diseases, including asthma, particularly if they are elderly.	

*any recommended concentration other than zero implies that a view has been taken on the tolerable levels.

Figure 3. Bandings for UK Public Information (DEFRA, 2002).

Descriptors like "satisfactory" require judgement via substantive public input - and can be disputed by sensitive and vulnerable individuals (Maynard, 2003). The Toronto medical community (Toronto Public Health, 2001) likewise contested Ontario's use of similar descriptors.

ADVISING THE PUBLIC ON PRECAUTIONARY ACTION

There is no element in this system of advising prudent avoiding action (e.g. avoiding energetic exercise when ozone is high) despite the chronic ill-effects now known. Though the UK now accepts that the chronic effects of PM exposure are many times greater than the acute effects (COMEAP, 2001), the public information was not changed. Only "sensitive" people are advised to take action - and asthmatics are told the pollution is not harmful as their inhaler reverses the effects (Figure 3). This reflects the UK regulatory culture - to avoid alarming the public.

The UK regime is based on the approach that "the risk to healthy individuals is very small at all levels of air pollution likely to be experienced in the UK" (Maynard & Coster, 1999)

Does this reassuring statement imply that only ill persons, with respiratory or heart conditions are at risk? In practice very many do suffer from air pollution (10-20%, including asthmatics) and they are called "sensitive." Infants and children are not, however, considered sensitive (Figure 3). During high pollution days, children with asthma are advised to continue take part in physical sports as normal, but just to use their inhaler more (DEFRA, 2002).

HEALTH-BASED STANDARDS – FAILURE FOR PM

The UK standards were intended to be health-based, using e.g. the "lowest effect" levels for SO_2 and NO_2. The standard for PM_{10} was set at 50 $\mu g/m^3$ (24 hr), despite WHO saying there's no threshold and despite evidence of effects down to 20 $\mu g/m^3$. The difference (30 $\mu g/m^3$) was deemed "acceptable," and calculated to give one hospital case per day in a city of 1 million people. Thus the current UK standard is based on the 1995 decision that PM_{10} if under 50 $\mu g/m^3$ denotes "very good" air quality.

The UK authorities are well aware of the American Cancer Society (ACS) and Six Cities long-term studies with the HEI "reanalysis" (see Craig & Shortreed, 2003), which established that PM has chronic effects on health, not just the acute effects from high pollution episodes as was accepted in 1995. The chronic effects cause ill-health in many of the supposed "healthy" individuals. The loss of life-years was given by the UK's Committee on Medical Effects of Air Pollutants (COMEAP, 2001) to be over 10 times higher than the loss via acute effects, probably over 25 times higher. They likened the harm to health to that from heart disease caused by ‘passive smoking,’ which is termed a ‘substantial public health hazard’. However, the chronic effects of PM pollution apply to the whole population, not only the 20% partners of smokers.

This sets the context for the question - how did the UK government respond to this substantial public health hazard? They confirmed weakened 24-hour standards on PM_{10} (allowing 35 exceedances/yr rather than 3) and proposed worsening the annual PM_{10} target for London (now 23 $\mu g/m^3$ instead of 20 $\mu g/m^3$). How was public information on air pollution changed? No change was made to the low/moderate description for PM_{10} in the 2002 version, as referred to above. The only ill-effects from PM were still given as worsening of heart and lung diseases. Just a sentence was added saying "experts suggest" long-term exposure to PM changes life expectancy. It does seem anomalous that the UK has scientific leaders in the field and that COMEAP produces a careful review concluding PM pollution is a serious issue, yet no UK scientists speak out over this cavalier treatment by government.

NEED FOR INFORMATION CRITERIA AND ACCOUNTABILITY

As the Conference *Concept Document* (Craig & Shortreed, 2003) states, it's important that messages concerning health effects and health protection provide an accurate reflection of the risks in a form that is easily understood. The Maynard-Coster criteria read, in amended form:

- to assist the public to understand the impact of air pollution on their health and the wider environment;
- to encourage the public to reduce emissions of pollutants within their control;
- to alert those who may be affected by air pollution to take timely precautions to avoid such effects; and
- to enable the public to assess progress in reducing air pollution towards harmless levels.

Assessing the UK provision according to such criteria is still needed as the criticisms above indicate. Toronto provided an impressive example of mismatch between information and reality, with the May 2000 study that showed all smog alerts in Toronto are triggered by ozone, while ozone is responsible for less than 5% of the premature deaths and about 30% of the hospitalisations attributed to air pollution. The study (Toronto Public Health, 2001) found 92% of Toronto's smog-related premature deaths and hospitalisations occur when the city's air quality is classified as "good" or "very good" by the Air Quality (AQ) index. The medical community rightly demanded restructuring of the AQ indicator and messaging system. Accountability in air pollution regulation, such as set out in the HEI methodology (2003), needs to be included as an integral element.

ADDRESSING THE PM-SIZE ISSUE

Ultrafine Particles – mismatch of science and UK policy

In Friends of the Earth, we caught onto the idea that ultrafine particles (UFP) are potentially the serious pollutant in 1996 when we were campaigning on industrial emissions. Seaton and colleagues formulated the hypothesis that particles smaller than 0.1 μm may be harmful just because such small particles cause inflammatory reactions in the lung. By the year 2000, the Royal Society meeting and book *Ultrafine Particles in the Atmosphere* (Royal Society,

2003) marked a watershed in acceptance that ultrafine particles are probably the most harmful fraction of PM and, second, that controlling PM_{10} fails to address the hazard of ultrafines because they contribute little to the total mass. Yet for public information and policy purposes, government officials and their expert advisors disregarded this science verdict.

Let me summarise the sad story of the treatment of PM by EPAQS, the advisory Expert Panel on Air Quality Standards. First, EPAQS (1995) recommended a UK Air Quality standard for airborne particulate matter PM_{10} of 50 $\mu g/m^3$ (as a running 24-hour average), which Government accepted. It was adopted into law in 1997 and was to be achieved by 2005 (99%ile). The favoured measuring device was the TEOM, of which many were purchased and installed (before the substantial under-reading due to heat-induced evaporation was discovered).

By 1999, international trends and lobbying from UK scientists had forced government to re-think; they accepted

- PM toxicity may lie in a finer fraction of the particles, perhaps below 2.5 µm or smaller
- PM_{10} measurements may include re-suspended dust of probable low toxicity
- difficulties in compliance where wind-blown dust or sea spray include 2.5 to 10 µm particles

The government asked EPAQS to consider an additional/alternative standard, taking account of the smaller size range thought to be responsible for toxic effects. However, EPAQS's draft report in 2000 proposed no change. It declared that a standard based on PM_{10}

> "would provide adequate protection for the public" (EPAQS, 2001).

The draft was heavily criticised, particularly for omitting much evidence on ultrafines and ignoring the increasing international use of $PM_{2.5}$, including by COMEAP. However, EPAQS (2001) stuck to their 'no change' stance, saying:

- PM_{10} is a metric that has stood the test of time
- no evidence that any alternative metric shows a closer and more reliable association with health outcomes
- They misrepresented critics as saying "it is only necessary to control the finer fraction in order to limit effects on health."
- They claimed that *in the UK*, $PM_{2.5}$ and PM_{10} are inseparable.

EPAQS did acknowledge that toxicological effects *may be* found in a finer fraction $PM_{2.5}$ or in ultrafine particles smaller than 0.1µm in diameter, poorly represented by PM_{10}. They nevertheless concluded that the "metric PM_{10} provides the *most appropriate basis* for a *UK* Air Quality Standard" (EPAQS, 2001). Only late in 2003, did EPAQS move reluctantly to accepting the international adoption of $PM_{2.5}$.

European Pressure

Pressure for action on PM and use of $PM_{2.5}$ has been building in Europe via the CAFE process and scientist committees in WHO (e.g. the January 2003 declaration that urban PM shortens lifetimes by 1-2 years (WHO, 2003)). This led to the European Commission's (2003) *Airborne particles and their health effects in Europe* in March, which tried to cut through politicians' reluctance by stating firmly

> "present levels of airborne particles are causing severe damage to human health..."

Unusually it needed the Commission to lead with firm statements:

- no apparent threshold of PM... no safe level may be defined
- reduction in life expectancy up to a few years
- $PM_{2.5}$ found to be more hazardous than the coarser fraction (PM_{10} – $PM_{2.5}$)

The Commission put down a marker on ultrafines:

- Ultrafine particles may... more research is needed to quantify.

The UFP story reveals a systemic failure

The Commission marker on ultrafines is too weak in view of the 4 years since the Royal Society (2000) watershed meeting (Royal Society, 2003) and abundant research findings. The issue that the Commission should have posed is - what kind of ultrafine PM monitoring and control system could be set up, as a first step for later refinement.

The mismatch between particulate toxicology and controls is increasingly glaring, the former finding that most and the most severe health impacts are related to ultrafines (nanoparticles), while the latter centres on micron-particles measured by $PM_{2.5}$. The main reason for the mismatch is the heavy investment in $PM_{2.5}$ monitoring and epidemiology, driven by the regulators, plus the attitude that controls on ultrafine particles are impractical (even "doomed to failure" said DEFRA's Martin Williams; "insufficient data on which to base a standard" said EPAQS (2001)). The limited evidence shows the UFP problem as worsening - data collected for the ULTRA project showed that ultrafine particles (<30nm, i.e. 0.03μm) increased through the 1990s in Erfurt while the levels of PM_{10} were steady and $PM_{2.5}$ were decreasing (Wichmann & Peters, 2000). Thus policies to tackle PM_{10} may well miss the major culprit for ill-health.

That the Background Papers and the *Concept Document* for the Rome AIRNET meeting missed out any mention of ultrafine particles is a significant failing, due in part to the issue being hardly appreciated in North America. The Policy Strategies and Options paper (van Bree et al., 2003) did quote the view that standard setting on the basis of the PM indexes is likely to be a sub-optimal strategy for managing particle pollution (Maynard et al., 2003) because of the different components. But it failed to raise for discussion the postulate that ultrafine size alone is the strongest indicator of adverse health impact - and strong enough for setting controls on urban pollution. Thus the AIRNET organisers' ducking of the ultrafines issue appears to mirror that of the Commission and much of the air pollution community.

The UK systemic failure on PM is perhaps unusual. But the ultrafine particle story shows a wider institutional failure within Europe, considering European scientists have been leaders in toxicology, epidemiology and measurement of ultrafines (Donaldson et al., 1999, Wichmann & Peters, 2000) and the 3-year old HEAPSS project focuses on this (Aalto et al., 2003, Lanki et al., 2003). There can be no simple answer, but openness is surely key as follows:

- scientists to work separately from policy people, as in WHO (not mixed as in EPAQS);
- international comparisons, scrutiny and best practice examples - where AIRNET helps;
- public access and involvement - which in practice must be via ENGOs;
- direct access of non-governmental groups (scientists and ENGOs) to the Commission.

RECOGNISING SUSCEPTIBLE AND VULNERABLE PERSONS?

It is increasingly recognised that individuals are susceptible not just through respiratory disease, but because their defence systems are immature (children), genetically limited, or compromised in exposure or health history. It is easy to criticise the blindness of EPAQS, when proposing their PM_{10} standard of 50 $\mu g/m^3$ (EPAQS, 1995), when they stated "the very large majority of individuals should be unaffected." One of their number has taken it even further by declaring only "exquisitely sensitive" individuals are affected (when giving evidence for an incinerator applicant at a public inquiry). The problem is not simply that scientist-experts ignored the susceptible, but that they did not realise they were stepping outside their science remit and exercising judgements that properly belong to a wider community and even to the political field. The UK has strong guidance (RCEP, 1998) that science advisory committees should not stray in this way, but the old culture remains strong (among officials who steer committees).

RCEP's guidance took EPAQS to task over an example of a pollutant for which there is no safe level of exposure, saying

> "any recommended concentration other than zero implies that a view has been taken on the tolerable levels of harm. Such a decision should not be taken by an ostensibly scientific body."

A clear separation of functions is required in handling scientific, economic, social and value issues in risk assessment and management. When air pollution standards are set and or other judgements made about environmental issues, the guidance says decisions must be informed by an understanding of people's values.

POLICY GUIDANCE ON SUSCEPTIBLE SUB-POPULATIONS

The EU policy guidance on susceptible persons has not been clear and consistent. The Fifth Environmental Action Plan said

> "all people shall be effectively protected against recognised health risks from air pollution"

The word "all" surely covers susceptible sub-populations and action is implied once risks are recognised. Questioning how are risks to be recognised, leads to the appreciation that implementing this proposition is not just science but a social/political process.

The Ambient Air Directive 96/62/EC ducked out of stating any principled objective. It talked in terms of ..avoid, prevent, reduce.. to limit values, or of setting target values (for ozone) where an absolute objective might be difficult or long-term. Till recently, WHO (1999) has led with the principle

> "to maintain a quality of air that protects human health and welfare… must also provide protection of animals, plants (crops, forests and natural vegetation), ecosystems, materials and aesthetics."

The EU's Sixth Environmental Action Plan's relevant objective (Article 7) reads

> "achieving levels of air quality that do not give rise to significant negative impacts on and risks to human health and the environment,"

which drops the promise to cover everyone. However priority actions (2a of Article 7) include

> "re-examination, development and updating of current health standards and limit values, including where appropriate, the effects on potentially vulnerable groups, for example children or the elderly."

Including the Unborn

Thus susceptible sub-populations are now explicitly covered. But are the unborn included? The AIRNET background papers refer to several recent studies showing pre-birth damage from air pollutants. "Saving the Children" (*Health & Clean Air,* 2003) also reviews the issue. CO and SO_2 are associated with low birth weight. Abnormal development (CO - holes in the heart; Ozone - defective heart valves etc.; PM - birth defects) appears to correlate with maternal exposure in second month of pregnancy.

There is no doubt that air pollution policy needs to include the unborn. They could be considered a 'vulnerable group' for the Sixth Environmental Action Plan, and legal clarification is desirable. In the meantime, let's proceed as if the unborn are included!

SCIENCE-STAKEHOLDER-POLICY INTERPLAY

The AIRNET Science-Policy Interface work group suggested in their conference draft (of 30/10/03) that scientists, policy-makers, stakeholders and the public are natural allies. Clashes at Rome on the conference floor showed, however, rather strong differences in views and interests between ENGOs, industry and policy-makers. Judgements on air pollution ranged from serious to marginal effects on health. The critical appraisal of UK policy-making in the text above also shows that the "natural allies" concept is over-simple. Picturing "science" as neutral is also problematic. Science can be divorced from reality and elitist as implied in Figure 4. ENGOs and the public are told only "sound science" counts, that results must be robust, that any challenge to established science requires "compelling evidence." Statistical correlations revealed via epidemiology are no proof. Thus science and scientists are raised on a pedestal. Questioning and campaigning are rejected as public hysteria, lay arguments are characterised as ‘thin pieces of evidence stitched together by strident activists to create an alarmist picture’.

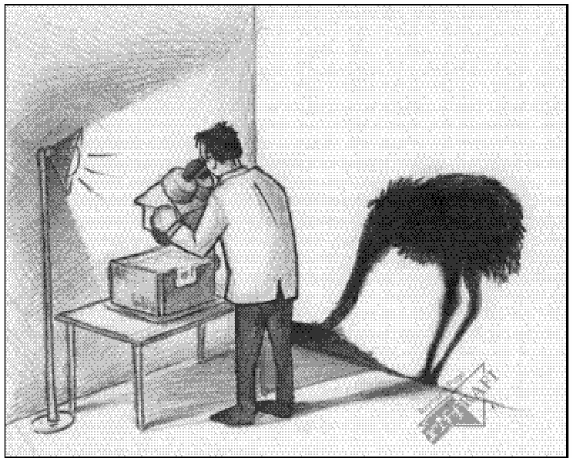

Figure 4: Science divorced from the real world.

The approach taken in the opening paper *AIRNET in Focus: Status report* (Brunekreef 2003) shows a way to counter this. This reminds us of limitations of the scientific process, from underestimating uncertainty and measurement error to publication and institutional bias. Weighing the evidence requires judgement that brings in a range of non-science factors; while scientists can try to minimise these they can't necessarily exclude them. In medical practice, the validity of public perception and knowledge, at some level, is increasingly recognised - the same should happen for health impacts of air pollution. Brunekreef also pointed out that asking for ever more solid scientific evidence ("sound science") can be an excuse for delaying decision-making, and so lead to "unsound" public health policy. Outstanding past failures from asbestos to nuclear radiation have been reviewed by the European Environment Agency (EEA, 2001) - this work includes a scholarly presentation of methodology for integrating the precautionary principle into science policy-making.

ENGOs and the public are becoming well versed in criticising risk-assessment toxicology, especially when presented with black-box numerology of complex computer programs. We tell the modellers they don't know if they've included all pathways, they lack data on combinations of pollutants, they cannot include unknown (trace) pollutants and their model of the standard human does not accommodate the wide range of susceptibilities. Modellers can reach opposite conclusions because of assumptions on data gaps and data extrapolation (Reid et al., 2005). We also remind the modellers that stakeholder participation is vital for risk analysis. Public acceptability of risks requires public participation in the decisions that create and manage such risks, including the consideration of values, attitudes and overall benefits. Sound public policy-making on issues involving science therefore requires more than good science: ethical as well as economic choices are at stake (EEA, 2001). Submerging risk in cost-benefit analysis does not avoid this and other criticism. It can help determine relative cost-effectiveness, but cannot tell us how far to abate air pollutants. The twist in the background paper (Rabl et al., 2005) of valuing a person's life according to her/his country's GDP per head runs up against objections of equity and of failure to include the non-market (social and informal) economy.

CONCLUSION

AIRNET is the type of activity that can moderate if not overcome the antagonisms. But there are histories of experience that cannot be disregarded. ENGOs generally see power hierarchies and privileged access, and use public campaigning to demand to be heeded by decision-makers. As far as we integrate in the Science-Policy Interface - reserving our right to campaign outside it too - we'd consider a model like that in Figure 5. This indicates how, for

European air quality, science currently feeds into a pretty open deliberative process with CAFE at the centre and outputs to EU level institutions. The question is - where should AIRNET position itself? If it chooses the right hand side of Figure 5, AIRNET claims privileged access to the Commission and policy-making processes. In that case, it is surely required to be accessible to all stakeholders, to be broadly representative and to operate democratically. AIRNET cannot fulfil that, if only because of its limited life. So AIRNET should be content with the left-hand position in Figure 5, helping Science feed into the deliberative mêlée, and designing its outputs for the participating parties and stakeholders. AIRNET can help integrate accountability into air pollution policy-making (HEI, 2003), via international comparisons and audits. The AIRNET project can make use of ENGOs as surrogates for the public stakeholder and aim to win them as allies in securing policy change.

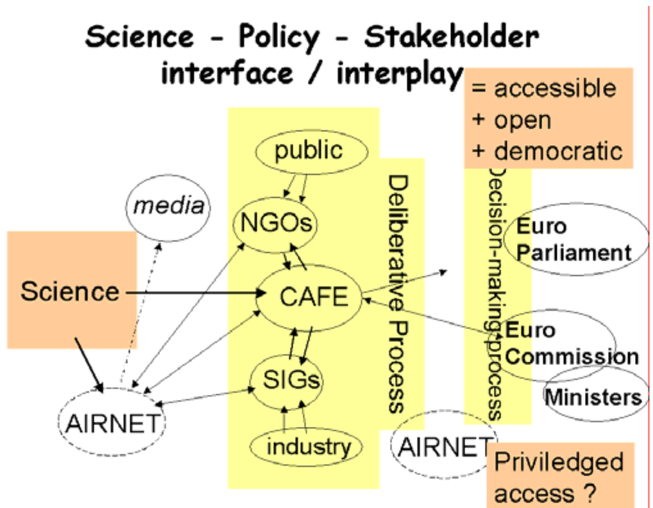

Figure 5: Where should AIRNET position itself?

Acknowledgement

Max Wallis is a research fellow in the Cardiff Centre for Astrobiology (Cardiff University, UK) and works with the Welsh ENGO Cyfeillion y Ddaear environmental network. He served for several years till 2002 as an ENGO representative (for Friends of the Earth) on the UK government's consultative Air Quality Forum. His presentation slides are found at http://airnet.iras.uu.nl/resource/flash/rome/0915_wallis_day3.php.

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