ASTA

International and National Abatement Strategies for Transboundary Air Pollution

Assessment by the Scientific Review Panel

May 29-31, 2002

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Annex 1 The Scientific Review Panel

Annex 2 Participants in the hearing, May 29-31, 2002

Conclusions and Recommendations

Phase I

The ASTA programme of MISTRA provides excellent scientific underpinning for the review of the Gothenburg protocol in 2004/2005, implementing the work of EMEP, IIASA and the Coordinating Centre for Effects in developing the effects-oriented approach successfully adopted under CLRTAP. It is equally relevant to parallel development in the EU. ASTA also provides a major contribution to the development of national Swedish strategies, and provides an in-depth analysis of the likely response of Swedish ecosystems to reduced emissions and deposition. There are major developments towards a flux-based approach for ozone critical levels, and addressing human exposure to fine particles as a new topic under the CLRTAP in relation to health effects. A further strength has been the inclusion of social science. The panel's overall assessment is highly favourable.

Phase II

The panel fully endorses the renewal request.

The panel recommendations are that the ASTA team:

- identify clearly the policy-oriented topics to be addressed in an interdisciplinary manner;
- integrate the social science and new area of environmental economics strongly with the physical and biological science;
- maintain support for basic science and experiments.

1. Introduction

MISTRA's programme on International and National Abatement Strategies for Transboundary Air Pollution (ASTA) is a solution-oriented, multi-disciplinary scientific undertaking set up to provide a science-based platform to facilitate further regulatory action on air pollution under the framework of the Convention on Long-range Transboundary Air Pollution (CLRTAP) and EU's Directives linked to the programme on Clean Air for Europe (CAFE). ASTA also supports the further development of national Swedish strategies and objectives related to air pollution.

Phase I of the ASTA programme has been running since 1998 and will come to its end in 2002. Prior to formal decisions about a possible Phase II of the programme, proposed to run from 2003 to 2006, MISTRA has arranged for an international, scientific assessment of the programme. The assessment panel was made up by:

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Prof. Helen ApSimon, Imperial College, London, United Kingdom

Prof. Jack Cosby, University of Virginia, USA

Prof. Alan Davison, University of Newcastle, United Kingdom

Prof. Alan Irwin, Brunel University, Uxbridge, United Kingdom.

The assessment panel reviewed the achievements of the programme and the individual activities as well as the proposal for a Phase II. Documents reviewed include the Synthesis Report of April 2002, the associated Progress Report and the outline of programme plan for Phase II. The panel had also access to several project reports and papers, as well as a list of publications, produced within the programme as provided by MISTRA.

The panel conducted a hearing with programme experts and managers at a meeting in Stockholm on 30 May 2002 and concluded its work on 31 May 2002.

2. Phase I of the Programme

2.1 Overall Relevance of the Programme

The programme offers a very relevant and timely focus on transboundary air pollution to follow the Gothenburg Protocol and EU Directives on emissions ceilings. It pays special regard to the relationship between international/ national strategies and scientific research. The programme covers a range of key issues, including acidification, eutrophication, tropospheric ozone, particulates and integrated assessment models. The programme also brings a social scientific perspective to bear on the relationship between scientific advice and the policy process. Taken together, the programme offers sufficient critical mass - and a sufficient coverage of key topics – to provide a solid foundation for national and international strategy.

Transboundary air pollution represents one of the longest-established environmental threats within Europe. Scientific research on these issues has a history since at least the 1960s. Whilst the problems of acid deposition, for example, are well-established, the need for coordinated data collection and analysis remains very high. Equally, certain matters have increased in importance in recent years (for example, issues of the relationship between air pollution and human health, biodiversity, new initiatives such as the CAFE programme of the EU). National and international strategies are still under development and it is vital that an appropriate research foundation be available to support this. It is also generally recognised that effective environmental action in this area has been greatly assisted by international scientific research. It is important for policy as well as academic reasons, therefore, that a broad research base be maintained and augmented.

The ASTA programme has made important contributions to this research base and is internationally recognized as a leader in this field. The workshops sponsored by ASTA as part of this programme are to be commended. The sponsoring of workshops promotes dissemination of the results of the project and involves external experts in the research. The investigators in the ASTA project have made important contributions to the peer-reviewed scientific literature and to the development of various documents used by the international community.

2.2 Scientific Merits of Individual Projects

A1 and A2. Integrated Assessment

This work complements that of the Centre for Integrated Assessment Modelling (CIAM) at IIASA, with emphasis on the representation of effects - in particular dynamic modelling. It draws strongly on the underlying science in part C of the programme. Thus the modelling with SAFE and MAGIC has been used to illustrate alternative ways of representing the temporal aspects of recovery in integrated assessment modelling and the RAINS model: and the work on ozone uptake by crops and forests is essential to development of an improved indicator for ozone damage to

succeed the use of AOT40. The contribution to modelling at EMEP-MSC-W will help to hasten delivery of source-receptor relationships for inclusion of particulate matter under CLRTAP. ASTA has also provided an effective link between national assessment and the CIAM - for example in the analysis of cost curves, emphasising the importance of restructuring and non-technical measures.

At the national level the research is closely linked to policies on forest management and use of wood for energy generation, as well as Swedish environmental objectives. The research under section C has fed through to provision of practical tools (validated models) and data to evaluate and map the response of Sweden's soils, lakes, forests, flora and fauna to past and future changes in deposition. The basic data towards characterising particulate exposure in rural to urban environments in Sweden is essential input to assessment of risks for human health, and policies on abatement.

Scientific approach

This part of the ASTA programme has acted as a catalyst in bringing together research in different disciplines to provide practical tools to aid policy development and analysis of abatement strategies. The focus on a new generation of indicators for effects to be used in integrated assessment modelling, and needs for national assessment and mapping, have successfully provided a clear aim for the more detailed gathering of data and analysis with both complex models and simpler techniques.

Dissemination

The ASTA programme provides a major input to work under the CLRTAP and more recently CAFE, both through organisation of targeted international meetings (e.g., the Saltsjöbaden workshop in 2000 following the Gothenburg protocol, and the workshop establishing ozone critical levels scheduled for November 2002), and interaction with specific centres, task forces and working groups. These include the Coordinating Centre on Effects and associated working groups on mapping and effects: EMEP on the modelling of ozone and particles; and the CIAM in development of an improved approach to representation of effects and benefits. There is also representation and input to CAFE working groups on particles and target setting.

Key presentations have also been made in the European arena including the treatment of uncertainties and future priorities, as well as technical papers and reports on specific aspects (e.g., critical loads/levels, dynamic modelling). Another important contribution has been the transfer of knowledge through training of scientists in other countries, especially with respect to dynamic modelling where data are potentially available for its effective application.

Capability of the research team

The early recognition of the effects of acidification in Sweden developed into an internationally leading role in scientific investigation of the effects of transboundary air pollution. This has been maintained, as reflected in the current team working on recovery from acidfication, nitrogen induced ecosystem changes, and ground level ozone. The same high standard has been maintained in more recently established

research on particulates. ASTA is also fortunate in having Peringe Grennfelt, an outstanding international scientist, to coordinate its activities.

Conclusion as to future work
This sub-programme represents an important contribution to scientific underpinning of further international effect to reduce transboundary air pollution in Europe. The practical application of the basic science can be exploited more strongly in future by more interdisciplinary interaction and groupings targeting specific problems and key policy questions. A useful extension is the inclusion of economic assessment, especially with respect to the strong emphasis in ASTA on the effects and benefits for natural ecosystems, lakes, forests and crops, and on human health in relation to particles.

B. Scientific processes behind abatement strategies - a social science perspective

One important characteristic of transboundary pollution abatement has been the close relationship between scientific research and national/international policy making. The relative strength of the science-policy connection raises further questions of how best to harness research for social and environmental benefit, and of how research findings can be disseminated to a non-scientific audience. The study of science-policy relations can also be of benefit to other areas of practical action (for example, concerning GM issues and global climate change). The inclusion of a social scientific perspective within ASTA represents a particularly important innovation within international environmental research.

Dissemination of results
Academic papers have either been published or submitted to national and international journals. These include *Sociologisk Forskning*, *European Journal of International Relations*, *Environmental Science and Policy*, *Environmental Politics*. One conference paper has also been presented. The papers are of a very high standard. In general, they focus on transboundary pollution abatement and its relationship to questions of technical expertise and public policy making. The papers suggest a good level of academic output and dissemination to an international audience.

Scientific approaches and methods used
The publications demonstrate theoretical and empirical sophistication. They successfully link issues of pollution abatement to questions of democratic governance and transparency, the role of science in public policy, and the character of environmental regimes. Particularly important use is made of the sociology of science and its treatment of science-institutional relations. The papers raise a series of social scientific questions which are central to the relationship between scientific research and international policy-making. This represents an especially novel and innovative aspect of the research programme. The bringing together of 'science' and 'social science' in this fashion should be commended.

Capability of the research team
The capability of the team is high (especially considering its relatively small size) and this has been augmented by research student involvement. It is extremely important that a new generation of researchers should be encouraged in this area. The publication record indicates that the team is of international standard and reputation. Once again, the integration of scientific and social scientific understandings is especially valuable.

Conclusions as to future work
The further synthesis of the technical, social scientific and policy dimensions of the ASTA project should be encouraged. The planned workshops will assist this goal. The completion of a monograph and of two PhD theses will represent significant deliverables. Engagement with identified research users (including national and international policy makers) will be extremely important in the final stages of this new project. The panel recommends that further consideration should be given by MISTRA to the general integration of scientific and social scientific perspectives within its activities. ASTA could provide an especially useful example for consideration by other programmes. It might be appropriate for MISTRA to consider further possibilities for the integration of scientific and social scientific perspectives within environmental research (e.g., through future workshops, joint activities and co-authored publications). The panel recommends that the ASTA project be continued.

C1. Acidification and Recovery

The focus of this sub-programme is to develop new tools for the inclusion of dynamic aspects of acidification and recovery into second-generation reduction strategies. This focus requires empirical data on actual system responses (for conceptual understanding of the relevant processes), and a means of quantifying and transmitting this knowledge to appropriate end-users. Phase I included both experimental and modelling activities.

The experimental activity (Activity 1) was primarily focused on the monitoring and analysis of changes that occurred at the Gårdsjön roofed experiment after the roof was removed. These data (and the data collected earlier in the project) were used to advance understanding of the processes of acidification and recovery and to test and develop models of these responses. Activity 1 also included a further examination and evaluation of previously completed regional analyses of surface water recovery in Sweden (based on the100 Swedish Reference Lakes and the more intensively studied PMK catchments). These observed regional trends were used to evaluate the regional applications of models in Sweden.

The modelling activity (Activity 2) included the testing of the MAGIC model using the results of the Gårdsjön roof experiment, and several regional applications of models to examine the projected responses of Swedish ecosystems to the changes in deposition occurring as a result of the emissions reductions protocols adopted in Europe to date (the Gothenburg Protocol). The SAFE, PROFILE and MAKEDEP

models were used to assess the recovery of soils in Sweden, and the MAGIC model was used to assess the recovery of lakes. The observed trends data for lakes (developed in Activity 1) were compared to the MAGIC lake simulations. No comparison to observed trends was available for the soils simulation. Models of both soils and lakes were used to evaluate dynamic critical loads for Sweden.

Dissemination of results

An impressive number of technical reports and publications in the peer-reviewed literature have been produced. The publications in the peer-reviewed literature deal primarily with analyses of the observed acidification and recovery trends in surface and soil water constituents and the modelling of those trends (8 papers). One paper (also a product of sub-programme A1) deals with the need to re-evaluate the critical loads concept. Two expert workshops on dynamic modelling have been organized under the auspices of sub-programme C1 (2 published workshop reports). The investigators have also presented their results as posters or invited talks at a number of international meetings (25 presentations).

The paper re-visiting the critical loads concept has contributed importantly to the new discussion of this issue. The posters and talks were given at important meetings (e.g., the 6th International Conference on Acid Deposition). Of particular note were the two workshops which drew experts from a number of countries. The workshops were very well received and have resulted in an active and ongoing collaboration of ASTA and "external" scientists. The committee suggests that the soil modelling activities should be better represented in the peer-reviewed literature.

Scientific approaches and methods used

The models used in this activity are relevant and have been widely applied (they are the right ones to use). The procedures used for collection of experimental data at the Gårdsjön catchment were the standard procedures used (and reviewed) in previous years. Both the experiments and models were focused on the relevant processes and variables for examination of acidification and recovery.

A strength of this activity is that it used, to a large extent, existing data bases from national and international agencies. There was also a good working linkage with scientists involved in European-scale assessment (e.g., IIASA). Another noteworthy characteristic of this sub-programme was the synergy between the modelling activities in ASTA and the modelling activities in other MISTRA projects, particularly SUFOR. The overlap in scope and coverage of the models in these two projects has been well managed such that both programmes have benefited from the other.

The use of dynamic models to evaluate recovery is currently very topical. The calculation of dynamic critical loads is a new idea that has been discussed conceptually in workshops but has been demonstrated only using hypothetical data. The estimation of the regional distribution of critical loads (using spatially distributed data to calibrate the models) is also a very new idea, but has previously been done only with static critical loads models. This sub-programme makes a first step in combining these two new concepts. The soils models were used to develop

dynamic critical load iso-lines for two sites (low and high weathering). The lake model was used to calculate dynamic critical load response surfaces for all 140 lakes in the lake survey data-base to which it was calibrated. The response surfaces were then summarized to produce a probability distribution function for regional critical loads. This is the first time this has been done with "real" lake data.

The development towards a dynamic critical loads approach (and particularly a methodology for presenting regional results of this kind of analysis) will provide a most useful product (input) for integrated assessment models (IAM). It will be important for the investigators to maintain an active dialogue with the IAM investigators and modellers to insure that the maximum utility of this concept is realized and that no confusion occurs. To this end, we recommend strongly that the dynamic modelling workshops be continued in Phase II of the project.

A key aspect of having this new methodology accepted will be confidence that the underling dynamic models can correctly simulate observed responses. The lake model has been evaluated by comparison to both experimental and monitoring data and can be shown to reproduce observed trends when properly calibrated. A similar evaluation of the soils model is more difficult because time-series soil data are rare. It would be beneficial to the programme, however, if some evaluation of the time trends simulated by the soil model could be attempted.

In the cases of both models, there needs to be some demonstration of the uncertainties involved in the analysis of dynamic critical loads. While this fact was recognized by the investigators at the hearing, there is no specific plan to address the uncertainty issue. This should be discussed in conjunction with those investigators working on the IAM activities.

There also needs to be an awareness in developing these techniques that it should be possible to associate a cost or benefit to the result. To that extent, the development (or expression) of dynamic critical loads should involve indicator values to which a cost can be attached.

Capability of the research team

The research team is well qualified and internationally recognized as leading experts in their areas of study. There is good communication among the team and with most other activities in the project.

Conclusions as to future work

The results to date (especially the development of techniques to use dynamic models to provide inputs for integrated assessment purposes) are of a very high quality and are leading edge in many respects. There is much left to do, however, before these new concepts on recovery and critical loads will be generally useful in an integrated assessment framework. Models are only as good as the data used to develop and test them, and we urge that this aspect of the project not be lost in the excitement of the new uses of the models. The team's plans for the next phase are a reasonable approach to the unfinished work. The project should proceed to Phase II.

C2. Nitrogen-induced ecosystem changes

Work in this sub-programme was aimed at determining ecosystem responses to low-to- moderate levels of nitrogen deposition.

Dissemination of results
Much of the research has already been published in international, peer-reviewed journals and the work will be presented at the forthcoming UN-ECE workshop in Switzerland, where it will contribute to discussion of the Critical Loads for effects on biodiversity. Examples of the important publications are: Lipson & Näsholm (2001); Strengbom et al., (2001, 2002); and Diekmann & Falkengren-Grerup (2002). There are also other publications that summarise findings, notably the *Effects of Nitrogen Deposition on Forest Ecosystems* published by the Swedish EPA. This publication deserves to be widely publicised within Europe.

Scientific approaches and methods used
Complementary approaches were used to study the ground-layer of northern coniferous forest, which is in a low N deposition area, and deciduous forest, which is in an area with higher rates of N deposition.

The coniferous study investigated some basic ecophysiological aspects such as the uptake of different forms of N, but it mainly concentrated on a large-scale field experiment. The former provides useful under-pinning of the more applied work and some of it is at the forefront of science, notably the work on uptake of organic N compounds.

There are many field experiments in Europe that are aimed at determining the effects of N deposition but the Umeå experiment has two features that make it unique. First, many previous experiments, particularly those in the UK and the Netherlands are in areas that have a long history of N deposition and in some cases, impact by SO_2 and acidification. This makes interpretation very difficult. In contrast, the Umeå site is in an area with very low deposition. Second, unlike all other experiments, the investigators used a range of plot sizes, up to 5000 m^2. This is very important because the effects on certain organisms (invertebrates and pathogens) can only be estimated using large plots.

The logistics of this kind of field experiment are complicated and there have to be trade-offs between the perfect design and what is practical. Because the investigators opted to use such large plots, it was impossible to apply the nitrogen at frequent intervals, as has been done in many other studies. However, the investigators´ use of a single annual application was appropriate and justified in the context of northern Sweden because most of the nitrogen flushes into the ecosystems during snow-melt. The choice of N species (ammonium nitrate, potassium nitrate, etc.) and the rates of application were appropriate for the Swedish environment.

The deciduous forest study relied upon a regional nitrogen gradient and multivariate techniques to determine the relationships between nitrogen and ground flora composition. This excellent work provided proof that the critical load has been

exceeded in parts of Sweden and is an invaluable record of detailed changes in the ground flora. This study provides a model for ecologists to use in other countries where there is an N deposition gradient.

Capability of the research team
The scientific quality of individual members of the team is excellent and the output is world-class. Continuing support in Phase II is fully justified. There is evidence of exchange of information and it appears that this will increase in Phase II.

Conclusion as to future work
The published output and work that will be presented at workshops later this year will make a significant contribution to basic science and to discussions of critical loads. Ever since the 1988 Skokloster meeting the definition of critical loads for effects on biodiversity has been based on the empirical approach. Although this has been useful and has stimulated research, it is scientifically weak. It is time to move on, to start working towards a more mechanistic approach and one that is integrated with other environmental events (acidification, climate change, etc.). The nitrogen team is now in the position where it can use its data and combine with other members of ASTA to make this advance.

C3. Ground level ozone

This sub-programme used the team's well established expertise to investigate several aspects of ozone that are important not only nationally but also internationally as a basis for the new generation of transboundary air pollution abatement strategies. It has provided a significant challenge to the use of the 40 ppb cut-off in critical level estimations.

Dissemination of results
Several important publications have already appeared in the international, peer-reviewed literature, notably those investigating a flux-based approach to critical levels, uptake-response relationships, effects on important forest trees and ozone-stress interactions. The work will make a vital contribution to the UN-ECE workshops later this year.

Scientific approaches and methods used
The approach and methods used were standard ecophysiological techniques and open top chambers, which are currently the most cost-effective systems to use for this type of work. Where this work differed from much of that done elsewhere was the emphasis on measuring gas exchange and estimating fluxes.

Capability of the research team
Individual members are internationally known for the quality of their work and they are widely cited in international journals. The ASTA output has continued with that high standard of work. The team is taking a world lead in developing a flux-based approach to pollution abatement and doing this in collaboration with colleagues in other countries – adding value to the ASTA programme. The author lists of the

publications demonstrate that there has been good collaboration between the institutes involved. Some components are linked to SUFOR.

Conclusions as to future work
The AOT40 concept has played a useful role in the abatement process. However, the AOT approach has severe limitations when applied across the diverse regions of Europe so it is time to replace it with a flux-based approach. Swedish researchers have already taken a lead role in this and the work that they have already produced has gone a long way towards fulfilling the ASTA objective of developing the next generation of transboundary pollution abatement strategies. A major, longer term challenge is to be able to produce a model that can be used across the diverse ozone and physical climates of Europe. Therefore it is important that the work be supported in Phase II.

The biggest challenge in estimating ozone fluxes is modelling stomatal conductance. Because stomata respond to so many factors, conductance is very variable and current models have a high degree of uncertainty. They tend to over-estimate conductance at low levels (ie they over-estimate ozone uptake). The ASTA team is well placed to make a major contribution to modelling conductance provided it receives support to continue its work.

The greatest progress has been made in relation to crops and forest trees but understanding the effects of ozone on natural vegetation and biodiversity continue to be under-investigated and under-funded in Europe. The ASTA team is one of the few groups working in this area. The panel recommends that its work on clover and grasses should be continued.

C4. Particles

There is growing evidence of a link between atmospheric concentrations of fine particles and health effects. This sub-programme is focused on measurements and modelling to characterise the long-range and local contributions to exposure, and support development of models.

Scientific approaches and methods used
Building on monitoring established within a Nordic network, the experimental research has concentrated on measurements of the size distribution and chemical composition of particulate samples. These fundamental data are essential for the subsequent analysis of the origins and generation of ambient particle concentrations and source apportionment, using techniques such as back trajectory analysis and multiple regression applied for principle component analysis with respect to chemical composition. The data also contribute to parameterisation of processes in modelling studies of atmospheric dispersion, where such information on particle characterisation, especially in rural areas, is very scarce.

The research has clearly demonstrated the importance of long-range transport for particulate concentrations in Sweden, even in urban areas, and the bimodal nature of the particulate spectrum above and below 1 micron.

Dissemination
The research is conducted in close collaboration with other activities on particulate PM10 in the Nordic countries, and provides a direct input into the development of modelling at EMEP-MSC-W towards inclusion of particles and their effects on health under the CLRTAP. There are also good links within Sweden including local authorities in urban areas and independently funded urban work: and with separate research on health related aspects and the particle characteristics responsible. The research is very actively reported in highly rated scientific journals, and through conference papers.

Capability of the research team
The research team had already established an international reputation in aerosol science from participation in EUROTRAC and EU Framework projects. The close links between Stockholm and Lund, together with meteorological colleagues in SMHI, provides a critical mass for effective research. The publication record of the team is exemplary.

Conclusion as to future work
This has been a highly effective component of the ASTA project, addressing a relatively new aspect where much fundamental research is required. The relative contribution of long-range transport of particulate matter compared with national and local sources is likely to be greater in the Nordic countries than most other European countries, and detailed characterisation of this portion will be extremely valuable to CLRTAP. The contribution to EMEP, within a Nordic cooperation, in development of a practical model for source apportionment of particulate concentrations is to be encouraged, with strengthening of links (e.g., greater direct input through mobility of researchers). The current level of support for this topic within the ASTA budget is relatively modest, and consideration should be given to increasing it.

2.3 Scientific Quality of the Programme as a Whole

It is clear from the preceding assessments of the individual sub-programmes that the quality of the science is uniformly very high. Much of the work is innovative, contributing to basic science and providing the basis for solutions to environmental problems. Some aspects of the research are unique and world-class.

2.4 International and National Networks

The workshops sponsored by ASTA promote advancement of scientific thinking and involve experts from Sweden and abroad. These workshops are extremely valuable in establishing networks of communication. The publication record demonstrates a high degree of national and international cooperation in ASTA. The ASTA

investigators are prominent participants in many international groups. The use of data from national agencies builds on existing research activities in Sweden and increases the utility of those programmes. The panel encourages the continuation of this national and international cooperation and urges MISTRA to fund these activities generously.

2.5 Recruitment, Training and Mobility of Researchers

The programme has had joint meetings, training classes for students and training workshops in dynamic modelling. These essential activities take time and money so they should be planned and budgeted in Phase II, particularly as they involve close collaboration. There has been strong interaction with national research programmes in other countries.

2.6 Importance of the Environmental Problems

Although there has been substantial progress in reducing pollutant emissions in Europe there is still much to be done to overcome severe effects from long-range transboundary air pollution. In this context Sweden's environment is particularly at risk.

The development and application of dynamic models to assess recovery from acidic deposition make a very important contribution to future integrated assessment activities. The use of these models to calculate dynamic critical loads for soils and surface waters will provide necessary information for second-generation reduction strategies. The ASTA programme is in the forefront of these activities.

Deposited nitrogen is one of the most important threats to biodiversity in Europe. It is a transboundary problem that will be expensive to solve so it needs impeccable science to act as the basis for abatement strategy. The ASTA programme is providing that basis and is in a position to take a lead in the UN-ECE and EU arenas.

Ozone is the most important gaseous air pollutant in Europe and it is a transboundary problem. It reduces crop yield and affects the growth of trees and other wild species. The development of a flux-based approach to ozone abatement will be a major advance.

Exposure to fine particulate concentrations is a new addition to the European agenda, in response to epidemiological evidence of adverse health effects. Long-range transport produces an important contribution, but still lacks basic data and characterisation.

2.7 Orientation towards Solutions

As indicated above, the ASTA programme is clearly focused on key issues for the Gothenburg protocol review, building on strengths in Swedish science on the effects of transboundary air pollution.

3. Plan for Phase II of the Programme

Overall the strength of research brought together under the ASTA programme provides the scientific authority to influence the future international development of strategies under CLRTAP and CAFE. This is strongly dependent on such national activities to provide the scientific underpinning on the costs and benefits of future action to reduce emissions.

The direct relevance will be enhanced by the greater interdisciplinary interaction envisaged in applying the research to specific problems and policy questions. These need to be very carefully selected. At the same time it is important to recognise the need of improved basic science for successful progress in future strategies to combat transboundary air pollution, and of maintaining a critical mass in terms of scientific experts and fundamental research.

3.1 Programme Structure, Priorities and Recommendations

The work on acidification and recovery and development of a dynamic critical loads methodology is fully supported by the panel. There seems to be a diminishing emphasis on examination of surface water recovery in the future work. We understand that the linkages to the national needs sub-programme require a thorough analysis of soil recovery responses (and models thereof). However, there is a considerable national expenditure for liming lakes in Sweden. We encourage the continued examination of surface water recovery and the use of existing lake survey data to develop dynamic critical loads for surface waters.

A considerable amount of money and effort has been invested in the Umeå field experiment so it important to maximise its use. Experience in other parts of Europe is that deposition experiments should be continued for as long as possible because effects take time to emerge at low rates of N addition (e.g., 6 k ha^{-1}). Also, the Umeå experiment is well placed to provide useful information on recovery of biodiversity. This is an important issue for policy makers because they need to know what they will get for their money. If biodiversity has been irreparably lost and the ecosystem will never recover, then there may be implications for abatement strategy. The problem is that there is so little known about recovery and there is little research on this in other countries. The ASTA team has made a good start by investigating old forest fertilisation sites and by converting the Umeå experiment to a study of

recovery. However, recovery is a slow process. The panel recommends that the Umeå study be continued for several years.

Support should be given to any experimental work necessary to develop the flux-based approach to ozone critical levels. Work is well advanced in relation to crops and trees in a northern European context but to maximise the impact of this Swedish contribution it needs to be extended to natural vegetation and other physical/ozone climates.

Research initiated on fine particles, their characterisation and source attribution, should be continued, together with international collaboration on model development and calibration.

The employment of an environmental economist represents a welcome consolidation of the social scientific perspective within the programme. The topic of Cost-Benefit Analysis (CBA) is also highly significant. While supporting the sub-programme of 'realisation, costs and benefits' in principle, it will be important to integrate this topic with the rest of the programme (for example, by drawing upon the social scientific work conducted within Phase I).

One particular issue raised by the Scientific Review Panel concerned the future integration of the scientific and social scientific elements of the programme. On the one hand, the value of social scientific research in this context was warmly supported and encouraged for Phase II. On the other hand, it was felt that there was considerable further potential for scientists and social scientists to collaborate across the programme. In this way, sociological research could supplement – and, as appropriate, modify – the work of scientific colleagues (for example, by exploring the relationship between scientific and policy concerns within particular projects and possibly re-formulating research questions). The theme of 'communication, uncertainty and transparency' proposed for Phase II has the potential to serve this integrative function but much will depend upon the level of interaction and cross-engagement that takes place across the research team as a whole. This also applies to the proposed involvement of environmental economists within the programme: the economists' perspective should be developed in close cooperation with the sociology/science and technology studies group.

The panel recommends that serious attention should be paid by the programme team to the integration of social scientific and scientific research as a precursor to Phase II funding. More specifically, the panel recommends that a more detailed work plan be prepared for this topic and that this should provide a clear outline of the organisation of the research, the methods to be used, and the integration with the programme as a whole (through joint activities, publications and workshops). Social scientific research has a large contribution to make across the programme. It may be that the level of funding needs to be re-considered in order to take account of this. ASTA should also consider the organisation of an international workshop which draws upon social scientists and scientists so as to consider the specific possibilities for future cooperation and integration. This will also further raise the profile of ASTA among the international social scientific community.

3.2 Programme Management

Overall, programme management has been very successful in Phase I. The panel anticipates that this will continue in Phase II.

3.4 Conclusions as to Proposed Extension of Funding

The panel strongly recommends that Phase II be fully funded.

Annex 1

ASTA

May 29-31, 2002

The Scientific Review Panel

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Annex 2

ASTA

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