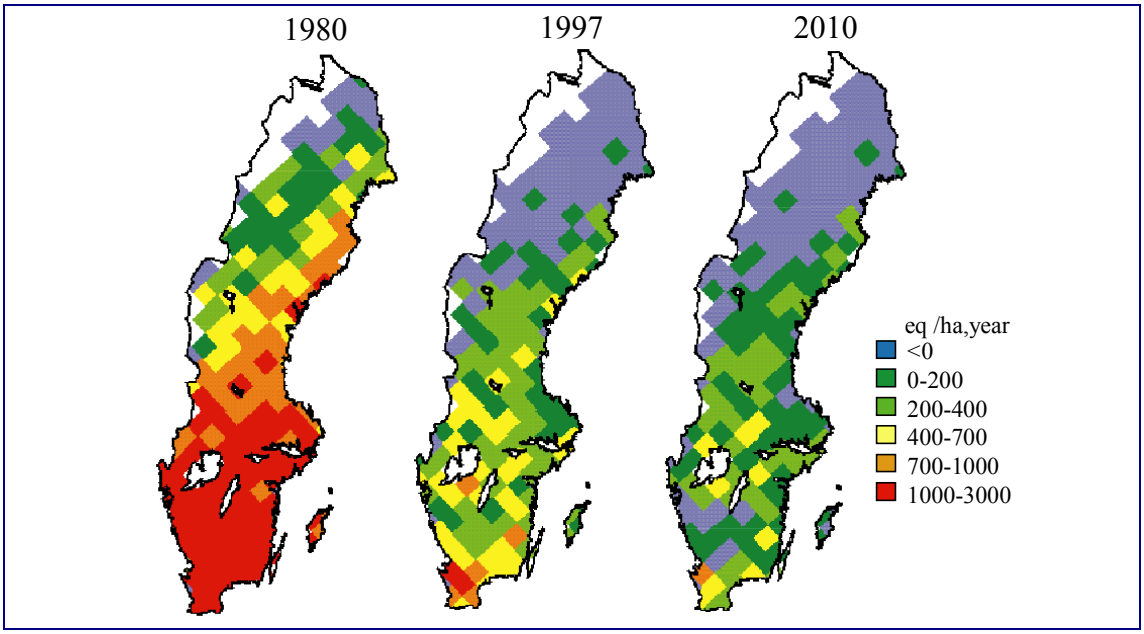
International and National Abatement Strategies for Transboundary air Pollution

International and National Abatement Strategies for Transboundary Air Pollution

Programme plan for Phase II

2003-2006



Exceedance of critical loads for acidification in Sweden 1980- 2010.

Summary

The objective of the Swedish research programme International and National Abatement Strategies for Transboundary Air Pollution (ASTA) is to support international agreements and EU legislation with scientific results, tools, evaluations and assessments. It has also the objective to support national needs for the revisions of the Swedish environmental quality objectives and the development of sector strategies. The programme is to its main parts financed by the Mistra foundation.

The first phase of ASTA covered the period 1999-2002. The second phase, which is described in this programme plan, will have a duration from 2003 until 2006.

The programme is divided into four themes:

Theme 1 Source-effect relationships, indicators and target setting. This theme is particularly directed towards the needs in connection with integrated assessment modelling, including those sub-models that are used. It covers four environmental problems:

- Acidification and its recovery
- Vegetation effects of nitrogen deposition
- Ozone effects to crops and forests
- Characterisation of long range transported particles

Theme 2 Realisation, costs and benefits is particularly directed towards the outcome of strategies in terms of improvements and towards development of tools and analysis of the economic benefits of further reductions. It also includes assessments of different scenarios, in particular those directed towards controlling greenhouse emissions.

Theme 3 Uncertainties, transparency and communication is directed towards the interaction between science and policy, the communication of science and how to deal with uncertainties.

Theme 4 Support to national strategies covers national aspects of the ASTA programme. This theme is aimed to develop tools and make assessments of various scenarios to support national strategies. This programme is to a large extent financed by other sources, in particular the Swedish Energy Agency and the National Board of Forestry.

The programme has an overall budget for the period of approx. 43 million SEK.

This programme plan has been prepared in collaboration with the ASTA scientists and the chairman of the ASTA Board. For further information and comments, please contact the programme director Peringe Grennfelt (grennfelt@ivl.se) or deputy director John Munthe (john.munthe@ivl.se).

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1. The problem

1.1 Introduction

The ASTA programme started in 1999 with the aim to support the revisions of the international agreements expected to take place within the Convention on Long- Range Transboundary Air Pollution and the European Union.

The original ASTA proposal from 1998 was based on a number of assumptions:

- There would be binding agreements on emission reductions in Europe within a couple of years.
- These reductions would not be sufficient to solve the transboundary air pollution problems in Europe.
- Future agreements on emission reductions would be based on similar concepts, i.e. reducing environmental effects in the most cost-efficient way.
- New negotiations were expected to start around 2005.
- Science will continue to be important for the success of any further negotiations and there will be increasing demands to reduce uncertainties in the scientific material.
- The underlying science will be further developed in order to take into account dynamic factors such as recovery of damaged ecosystems.

Today, at the doorstep to Phase II, we know that the international work on transboundary air pollution follows the assumptions from the original ASTA proposal. The concepts applied for the Gothenburg Protocol and the EU NEC directive are presently used in the development of the new strategies.

There are however some important differences:

- Health aspects have increased in importance and are a main driving force for emission reductions.
- There seems to be no discussion or conflict whether CLRTAP or the European Union will take the lead in the work on transboundary air pollution. Instead, the two systems have developed strategies in parallel and in collaboration, with CLRTAP continuing on the problems already handled within the Convention and EU, through its CAFE programme, giving particular priority to local air pollution, particles and effects to human health. The CAFE programme also puts particular emphasis on scenarios and linkages to other EU policies.

The original hypotheses and objectives for the ASTA programme will therefore essentially remain for the second phase.

Activities within the ASTA programme have been and will continue to be linked to these European activities. In addition, ASTA will support national Swedish actors on issues related to transboundary air pollution.

It is generally accepted that the successful international co-operation on developing our scientific understanding of biological, chemical and atmospheric processes related to the impacts of transboundary air pollution has provided a consensus-forming force within the Convention. This has strengthened the political processes, which have resulted in successful

agreements on emission control in Europe. The activities of ASTA have to be viewed from this perspective. Indeed, ASTA with its clear focus on supporting the political decision making process, can be regarded as a policy-driven research programme; all parts of the ASTA programme have had clear objectives of supporting the policy process, although at different levels and with different degrees of direct interactions.

1.2 Experiences from Phase I - consequences for Phase II

ASTA has striven to play an active role in setting the agenda for scientific support to the revisions of the Gothenburg Protocol and the NEC Directive. This role has included basic research in order to develop new knowledge within crucial areas, e.g. particulates and biodiversity. It has also included more directed research and model development to support the synthesis and integrated assessments forming the basis for the international agreements and EU legislation. This has been the case when developing new concepts for critical loads for acidification and critical levels for ozone effects on vegetation. Finally, ASTA has also made use of its direct channels into the process, by taking initiatives to arrange international workshops on subjects, which were judged to be crucial for the continued development of the abatement strategies. The evaluations undertaken during spring 2002 as well as direct contacts with the bodies under the convention have confirmed that ASTA has made significant contributions to the process of developing the scientific basis of future protocols.

ASTA intends to continue and intensify its activities to support policy through synthesis of results from basic research during Phase I and, in particular, through model development and application. We also will make use of the knowledge on science-policy relations (the social science part of the programme) developed under Phase I, in particular for the development of communication strategies between science and policy. Increased integration of social and natural science is one of the major challenges of Phase II.

Going from Phase I to Phase II of the ASTA programme, the research will to a large extent evolve from its disciplinary nature towards a much higher degree of synthesis and integration. The focus will be on the combination of different types of information and evaluations from which decision-makers can benefit especially those linked to CLRTAP and the CAFE programme of EU, but also the national stakeholders of the ASTA programme. Therefore we propose a new structure of the programme and its activities for the four-year-period to come in order to meet the demands in a more efficient way.

1.3 Significant overall developments of importance for the priorities of Phase II

Since the signing of the Gothenburg Protocol we have identified a number of trends in the international, especially the European, research and policy development, which are relevant for the ASTA programme. These include:

- The “static” critical loads concept for acidification is no longer sufficient as a basis for future abatement strategies. Instead a dynamic concept has been developed which takes into account the recovery time of ecosystems in acidification assessments based on critical loads. ASTA scientists first proposed such a concept at a conference in Copenhagen in 1999. This event started a process to find solutions to the problems associated with the inclusion of dynamic aspects in integrated assessment modelling. Today we are on the verge of international consensus on how these processes can be handled in mapping critical loads and their exceedances as well as in integrated assessment modelling. This work will be finalised during the first months on Phase II.
- The research on the effects of nitrogen deposition on biodiversity in various ecosystems has been intensive in several countries during the last five years.

Ecological effects have been considered on a mechanistic level to a larger extent than earlier, and sensitive receptors have been identified in more detail. This has had profound consequences for the revision of the so-called empirical critical loads, which are presently used for nitrogen effects on biodiversity. Biodiversity has become an increasingly important impact criteria during the last few years.

- The scientific interest in air pollution effects on human health has increased considerably during the late 1990s and early 2000s. This is especially true for the effects of fine particles, but to some extent also for other pollutants, such as nitrogen oxides and ozone. Large-scale epidemiological studies indicate that air pollution in many European cities cause increased mortality and other serious health effects. Research activities in Europe also include, in addition to the epidemiological studies already mentioned, investigations of toxicology, atmospheric processes and development of accurate measurement methods for fine particles, the latter including determination of both chemical composition and physical properties of the particles. Major on-going activities are mapping and characterising the particles and model development. Several major studies on how air pollution affects the general population and especially sensitive population groups, such as elderly and children, are ongoing.
- In the field of ozone/plant interactions, research performed during the last five years has shown that ozone fluxes and ozone uptake are more relevant indicators of the effects on vegetation. Going from critical levels based on concentrations to critical levels based on ozone uptake is however a complicated step, since ozone uptake is regulated by a large number of environmental, climatic and physiological factors.
- The Integrated Assessment Modelling (IAM) within the CLRTAP/CAFE is likely to become significantly more complex before the revisions of protocol, directives and strategies for several reasons. *1*. The particle-health problem will be included in the modelling. *2*. Dynamic models will most likely be used for acidification and ground-level ozone; critical loads for nitrogen will also be changed. *3*. The development of suitable methods and increasing demands from policymakers has led to an increasing activity in the field of more sophisticated uncertainty analysis. Alternative methods for developing cost-effective solutions may also be considered.
- For some atmospheric pollutants (mainly particles and ozone) impacts occur on both local and regional scales. Integration of abatement strategies for urban areas and for transboundary transport is thus necessary.
- The expansion of EU to several countries in central and east Europe is a key issue, which has to be considered in future air pollution strategies. A larger EU will influence many areas of importance for air pollution, e.g. the transport sector, where an expanded common market is expected to increase transport substantially (EU white paper on Transport) but also other sectors such as agriculture and energy. EU enlargement is an important issue - new EU countries are also obliged to fulfil the EU environmental directives which are expected to decrease emissions e.g. from combustion plants.
- The development of the main sectors in Europe (energy, transport, agriculture and industry) is of crucial importance also for emissions and the control needs to fulfil air pollution objectives. Scenario analyses are therefore important activities for the development of strategies. At present the development of so called baseline scenarios is one of the most difficult tasks in the preparation of the underlying material for the revisions due to uncertainties with respect to the implementation of the Kyoto protocol and also due to uncertainties concerning the consequences of the above mentioned enlargement of EU.

- The development of cost-benefit models and other valuation methods for various endpoints has become more important. Since the measures to counteract air pollution are getting more and more costly, the economic value in terms of lower environmental costs as a result of reduced pollution has become increasingly important.

2 Overall objectives and benefits to stakeholders

The overall goals for Phase II of the ASTA programme are:

1. To support the LRTAP convention, especially the revision of the Gothenburg protocol, with scientific results and analysis tools, evaluations and assessments.
2. To support the CAFE programme of the EU, in particular the revision of the National Emissions Ceilings directive (NEC) and the air quality directives/strategies with scientific results, analysis tools, evaluations and assessments.
3. To support national Swedish negotiators and policy makers, active in the LRTAP and CAFE processes, with appropriate scientific information, tools and assessments for the national strategy.
4. To provide relevant information for the revision of the national Swedish environmental quality objectives, of which is the first is expected to take place in 2003/2004 and possibly a second in approximately 2007.
5. To provide scientific information concerning transboundary air pollution, LRTAP and CAFE to Swedish societal sectors and organisations (forestry, energy etc), which support the ASTA programme, as well as to make it available to the Swedish community and its citizens in general.
6. To include the interactions between long-range transport of air pollutants and forestry (whole-tree harvesting, wood-ash recycling, compensation fertilisation) in the scientific basis used in national assessments of land-use and forestry alternatives.
7. To improve the general scientific understanding of transboundary air pollution and its effects, and to communicate this to stakeholders and others interested.

More detailed goals are found below, under point 5.

2.1 Potential benefits to stakeholders

As already mentioned the most important activities for ASTA on the European arena are those within the LRTAP convention and the CAFE programme of the EU. ASTA will closely follow all the work under these bodies and contribute where appropriate. ASTA will continue to take initiatives to workshops, assessments, improvements of manuals etc. The ASTA board will take decisions on these activities.

Activities and competence are developed in the ASTA programme in order to follow and interact with most of the bodies under CLRTAP and EU CAFE. The relations with CLRTAP's different bodies are illustrated in Figure 1. In Table 1, the expected time schedule of LRTAP and CAFE is put into perspective of the suggested activities of the ASTA programme.

In line with the time schedule outlined in the table below it seems reasonable that the ASTA programme continues until 2006 in order to support the decision process within EU/CAFE. A shorter programme will mean that the knowledge and information generated within ASTA will not be available to the decision-making bodies in Europe and in Sweden.

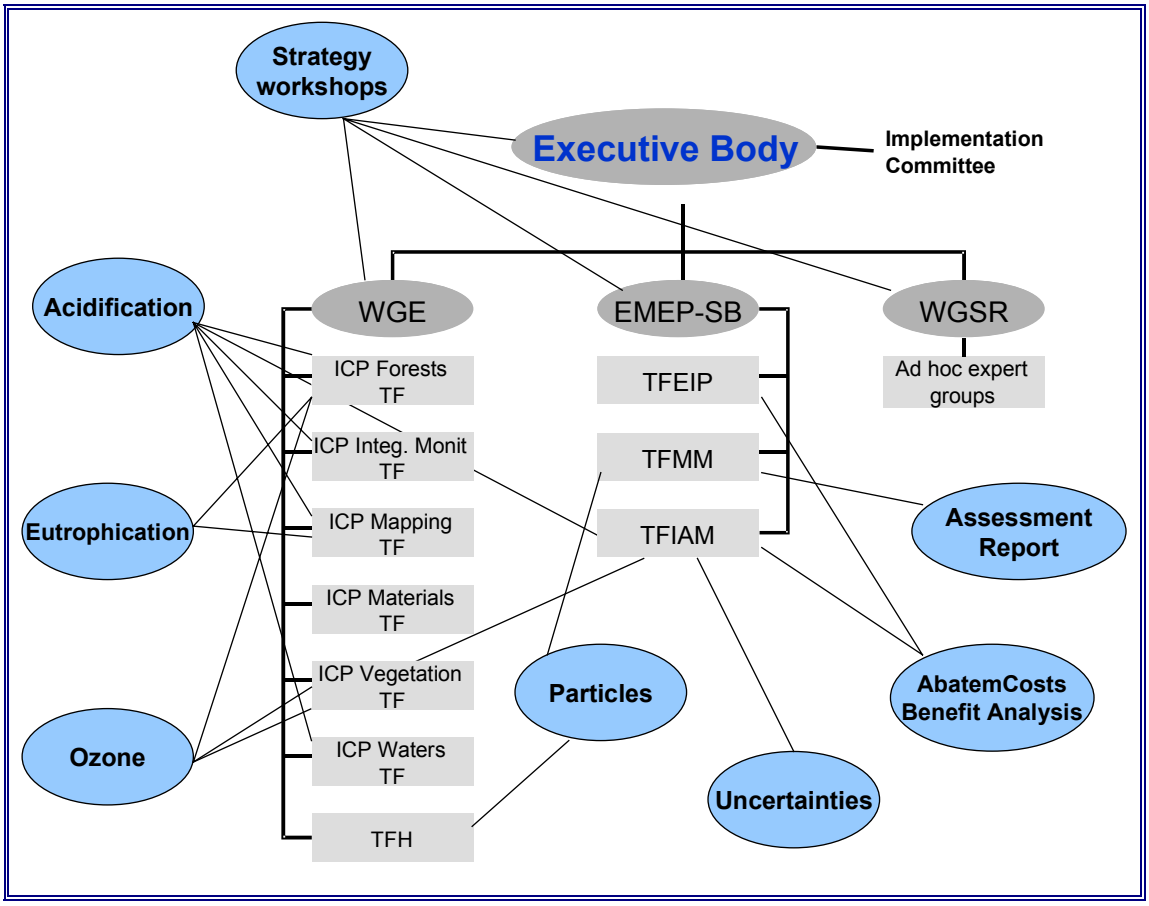

Figure 1 The relations with CLRTAP´s different bodies and ASTA research. ASTA activities are marked in blue.

Table 1 Activities within LRTAP and CAFE, and the related activities within the ASTA programme during the period 2003-2007.

Year	Major ASTA activities	LRTAP	EU/CAFE
2002 autumn	Workshop on dynamic modelling, Sitges Nov	Acidification targets based on dynamic modelling	
	Identification of important air quality indicators for monitoring and modelling.		Participation in CAFE WG on particles. Guidance on sampling of PM.
	Modelling development and evaluation of PM	EMEP PM model revision	Support for Measurements and atmospheric modelling group.
	Active participation in workshop on critical loads for nitrogen, Switzerland, November	Revision of critical loads for N effects on diversity	
	Organisation of Level II ozone critical levels workshop, Gothenburg, November	Finalising Level 2 Critical Levels for ozone	
	TFEIP Workshop on validation on emission inventories, Gothenburg October	Preparation for TFEIP	Preparation for IAM
2003	Active support to revision of mapping manual for dynamic modelling, nitrogen, O_3	Revision of Mapping Manual	
	Active support of mapping of CL for acidification etc.	Mapping	
	Identification of important air quality indicators for monitoring and modelling.	EMEP monit. protocol.	Participation in CAFE WG on particles.
	Modelling development and evaluation of PM.	EMEP PM model revision	ASTA organises CAFE workshop on particles
	ASTA CAFE meeting: "Regional scale particle models – results, evaluation and implications"	Support to TFMM	Support to Measurem. and atm. modelling group.
	Examination of baseline scenarios and abatement cost data	IAM model developm.	IAM model developm. Baseline scenarios
2004	ASTA conference: "Legitimacy- scientific and social – in air pollution abatement in Europe"		Thematic strategy of CAFE
	Validation of maps	Updated maps	
	ASTA conference (workshop) on the concepts and support of CAFE and CLRTAP strategies (Saltsjöbaden 2)	Report on long term changes in atmospheric composition and deposition (collaboration with ASTA)	
	Report on uncertainties source receptor relationships	Workshop. Report to CLRTAP.	
2005	ASTA conference: "Costs and benefits of the implementation of abatement strategies against transboundary air pollution"	Negotiations will start	Proposal from Commission of revised directives and strategies for local and regional air pollution
	Benefit module for environmental effects.	Information on costs and benefits	Info on costs and benefits
2006	Book on effect quantification, critical loads and levels	Negotiations	Processing through the Council and the Parliament
	Final reports of the ASTA programme	Revision of Gothenburg protocol	
2007			Final decision by Council and Parliament

3 Directions and programme structure

The interaction between science and policy will increase during the second phase and ASTA will act as an important communication partner throughout the preparation and negotiation process. To fulfil this objective it is necessary that the programme can continue throughout the negotiation process and thus ASTA Phase II will continue until 2006. The work with the Gothenburg Protocol led to the experience that continuous scientific input is essential for the success of the process, even after the input to the more obvious science-driven process of integrated assessment modelling has been completed. Due to the expected intensive work with the development of strategies during 2003 and 2004, the programme will focus most of its activities to the first two years. This is especially the case for the development of control strategies, e.g. new concepts for critical loads and levels and characterisation of particles.

For some of the other issues included in Phase II, the timing is less crucial with respect to the strategy developments and activities are planned to continue over the whole programme period. These include:

- Evaluations and assessments of the outcome of already undertaken measures
- Cost-benefit analyses and other evaluations of additional control measures
- Uncertainties and confidence in the proposed IAM-based strategies

Even if the programme has a strong direction towards policy, the overall ASTA will still keep a high scientific standard and innovation climate and ensure that results will appear in per review journals.

3.1 A new organisation of the work

Our intention is to reorganise the ASTA programme around four interdisciplinary, principal Themes:

Theme 1: Source-effect relationships, indicators and target setting

Theme 2: Realisation, costs and benefits

Theme 3: Uncertainties, transparency and communication

Theme 4: Support to national strategies

These themes constitute a complete change in organisation structure in comparison to Phase I (Figure 2). The aim is to more clearly focus on the interactions between basic science and the policy development as well as the needs of other stakeholders.

During Phase I a substantial part of the programme was directed towards syntheses, assessments and communication of results from the programme. This activity was organised within a certain sub-programme “Centre for Evaluation and Assessment”. It was successful in its ambition to provide a basis for international communication between science and policy and to form scientific consensus around certain issues, e.g. how recovery could be handled in connection with integrated assessment modelling and how to improve quality in emission inventories. These activities will therefore be further expanded and integrated in all parts of all the four themes.

As was the case in Phase I, decisions on which evaluations and assessments to do will be taken by the ASTA board in close collaboration with the programme director.

The earlier organisation of Phase I will thus be almost completely abandoned. The new direction and organisation of Phase II of the ASTA programme will lead to increased collaboration between the existing ASTA groups and also to a split of scientists in the present groups to the different sub-programmes. The needs for an increased collaboration with groups outside of ASTA will also be more pronounced.

A schematic sketch of the ASTA Phase II organisation is presented in Figure 2.

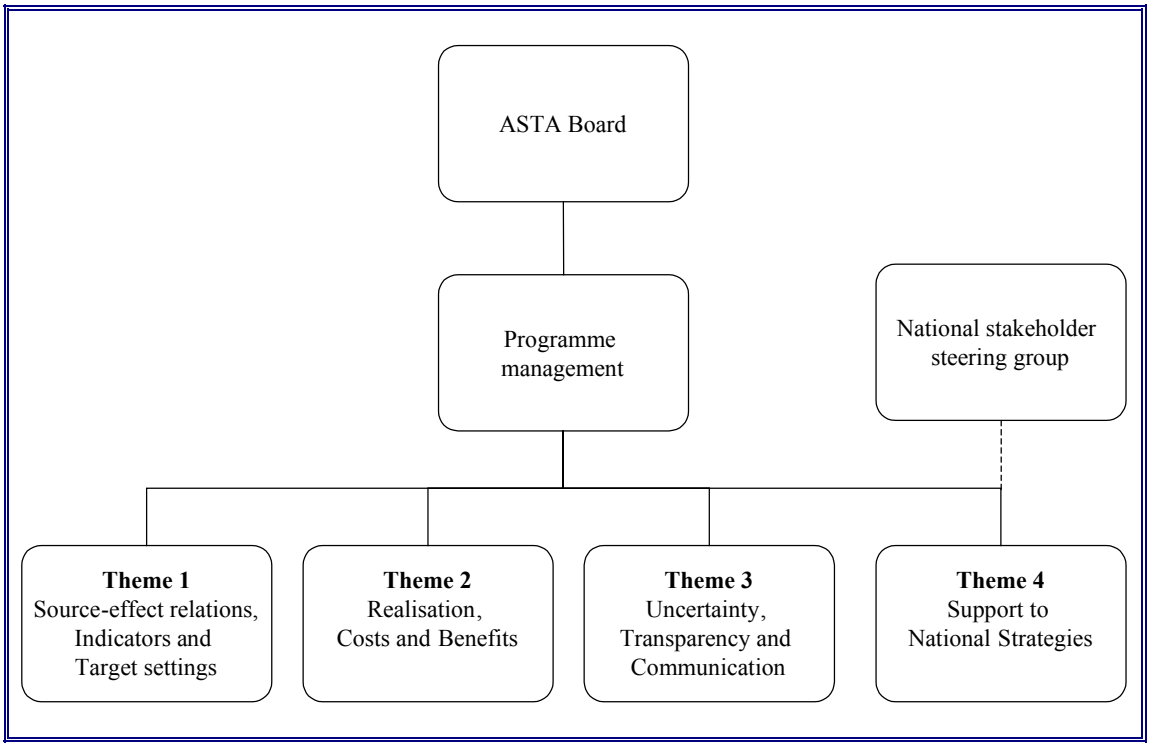

Figure 2 The organisation of ASTA Phase II

3.2 Organisation

ASTA has benefited from a very active and highly qualified board, which to a large part has remained intact over the first phase. This board will largely remain during Phase II. The members of the board are presented in Table 2.

The programme management of ASTA Phase II will consist of the programme director and a deputy director. In addition there will be a Steering Group composed of the programme directors, the co-ordinators of the four themes and 2-3 additional leading scientists. As in Phase I, the programme director is responsible for the overall progress of the programme as well as being the main contact with the ASTA Board and MISTRA. The programme director is assisted in these tasks by the deputy programme director.

The Theme Co-ordinators are responsible for the progress of the work in the four themes. This includes facilitating the co-operation within and between the themes as well as the administrative responsibility for funding, reporting etc.

The secretariat will establish an internal homepage in order to facilitate the communication with and information from the various international bodies of importance for the development of the transboundary air pollution policies. The information system will contain e.g. reports from the participation in meetings and workshops, timetable for meeting etc.

The national programme (Theme 4) will have a reference group with representatives from the funding agencies and other stakeholders. Key persons from research programmes and other activities with a central interest in the issues under theme 4 (e.g. the Mistra programme SUFOR) will also be invited to participate in the reference group. The homepage will contain similar information with respect to national needs.

The ASTA Phase II programme will work with budgeted activities in relation to deliverables in more stringent way than under Phase I. This will enable the programme to keep the focus of the programme and to make changes and additions to the programme in relation to achievements and policy needs.

The persons involved in the management and co-ordination of the ASTA Phase II are presented in Table 3.

Table 2 ASTA board members.

Function	**Name**
Chairman of the Board	Lars Lindau
Board Member	Gunnar Hovsenius
Board Member	Anton Eliassen
Board Member	Anna Lundborg (adj)
Board Member	To be named by Swedish Forestry Board
Board Member	Jan Nilsson (adj)

Table 3 Management and secretariat.

Function	**Name**
Programme Director	Peringe Grennfelt
Deputy Programme Director	John Munthe
Co-ordinator Theme 1	Håkan Pleijel
Co-ordinator Theme 2	John Munthe
Co-ordinator Theme 3	Peringe Grennfelt
Co-ordinator Theme 4	Olle Westling
Steering Group Member	Göran Sundqvist
Steering Group Member	Harald Sverdrup
Steering Group Member	Hans Christen Hansson
Steering Group Member	Torgny Näsholm
Programme secretary	Jenny Arnell

4 National and international collaboration

4.1 Scientific collaboration

The scientific groups active within ASTA are already well established in different European scientific networks, some of them with EU funding. ASTA will make use of these networks even in Phase II, in particular for scientific discussions and for the formation of consensus on crucial environmental issues. ASTA will also assess the possibility of a participation in the new EU research programme.

ASTA will intensify its international scientific collaboration with CLRTAP centres and ongoing international projects. This collaboration includes in particular a close collaboration

with the Centre for Integrated Assessment Modelling at IIASA, the Coordinating Centres for Effects on implementation of the new concepts on critical loads and levels and MSC-W on particulates. ASTA scientists also participate in several international projects. One such project is the NEPAP network with the aim to support the CAFE programme with scientific expertise.

On the national, Swedish scale, there will be strong links between ASTA and other research activities. Collaboration with some other Mistra programmes, such as MARE, SUFOR, SWECLIM, LUSTRA and RESE, is expected to be well developed during the four-year period to come. The well established collaboration with SUFOR will continue and result in model tools that in a more appropriate way may be able to support decisions on forest production and environmental policy.

Other major Swedish research programs, BHM and SNAP, are focusing on developing assessment tools for particle sources as traffic and wood combustion as well as investigate health effects related to these particle sources. The collaboration with these programs will further increase as they move into a syntheses phase aiming to support a major change in the energy sector towards use of renewable energy sources with compliance to the environmental quality objective of Clean Air.

5 Proposed sub-programmes

The four proposed sub-programmes are outlined in somewhat more detail below:

5.1 Source-effect relationships, indicators and target setting

The LRTAP and EU activities to combat transboundary air pollution are presently based on effect criteria such as critical loads for acidification and particles concentrations for health. In order to improve the scientific basis for decision-making, a continuous updating of the dose-effect- and source – receptor relationships is necessary.

Source-effect relationships and effect indicators used within the European co-operation on transboundary air pollution are presently in a process of strong development from relatively general, “static” concepts used for general risk analysis (Level I in the vocabulary of the LRTAP convention) towards dynamic concepts aimed at estimating actual effects (so called Level II) and recovery times of ecosystems.

Theme 1 of the programme is focussed on supporting the development of integrated assessment modelling with concepts, criteria, indicators and background material for target settings. The work will to a large extent be based on the work taken place in the A1:2 and C1 – C4 activities of ASTA Phase I. The results obtained in Theme 1 will be presented and evaluated in appropriate international frameworks (workshops, conferences) and communicated to the Integrated Assessment Modelling (IAM) community. The analyses and assessment will be published in the scientific literature. The activities in Theme 1 represent different environmental impact categories of transboundary air pollution and also different levels of maturity within the science-based system of policy making. They do, however, all share the general objective of improving the scientific basis for decisions as well as the modelling tools used for optimisation of international strategies to reduce impacts of air pollution.

Theme 1 is focused on five scientific areas, which will be organised in five different projects:

1.1 Development of models for assessing vegetation changes in terrestrial ecosystems affected by nitrogen deposition
1.2 Application of dynamic models to estimate future acidification status of soils and surfacewaters from acidification
1.3 Finalisation of models for ozone effects on crops and forest trees and implementing the level II concept for ozone
1.4 Refinement of source-receptor relationships for long range transported particles
1.5 Development of a dynamic model for the assessment of combined ecosystem effects

The work is in most areas already well under way and results will be reported to LRTAP bodies continuously in support of the EU CAFE programme and the revision of the Gothenburg protocol. Most of the results need to be delivered during the coming two years.

Assessment of vegetation changes (project 1.1) will be based on experimental results obtained in ASTA Phase I and II. The experimental work will continue for 1-2 years mainly focussing on follow-up of the previous experiments. A smaller experimental activity focussed on the impact of nitrogen deposition on lingonberries in nutrient poor forests will also be made. The modelling activity will focus on three main issues:

1. Determing the dose-effect relationship and design of model concept for indicator species in Boreal forests (blueberries and lingonberries).
2. Determing the dose-effect relationship and design of model concept for indicator species in Nemoral forests.
3. Development of computational model based on the results of 1 and 2 and further generalisation by including known dose-effect relationships for other species and other potentially relevant factors (e.g. climate) (activity 1.5).

With a generalised model, the possibilities to include a number of other vegetation species relevant to conditions in continental Europe increases and thus the potential policy impact of the results. Due to the complexity of the interactions between nitrogen deposition and vegetation response and an upcoming European workshop on nitrogen effects in November 2002, the work in project 1.1 and 1.5 will be further planned at an internal ASTA workshop. A detailed work-plan will be prepared after this workshop and after additional consultations with international expertise.

ASTA will continue to contribute actively to the revision of the Mapping Manual of the CLRTAP in several ways, by participating in meetings and making suggestion of revisions in the manuals. We intend to continue and to broaden the contribution of ASTA to discussions of what criteria to use for acidification, eutrophication, ground-level ozone and particles-related problems. Our goal is to ensure that mapping and monitoring activities along the new lines are undertaken in the whole of Europe. Several bilateral contacts are planned, in particular for the implementation of dynamic modelling of acidification and its recovery.

Projects 1.2. and 1.3 are continuations of the work on recovery of acidified ecosystems and effects of ozone started in Phase I. The main focus of Phase II is to apply models on the European scale.

The work on atmospheric particles within Theme 1 will contribute to the development of process models and to characterisation of physical and chemical properties of particles in relation to their sources and transport distances. Measurement activities are planned for year 1 and year 2 to be followed by synthesising and assessment work. ASTA Theme 1 will also be the main co-ordinating activity for communicating and synthesising research in other national and international projects to the CLRTAP and CAFE.

The modelling of vegetation changes caused by nitrogen deposition will be performed in project 1.5. The vegetation model will also be linked to an integrated modelling tool for combined ecosystem effects. This will focus on integrating impacts in Boreal forest ecosystems of deposition of nitrogen and acidity as well as forest management and climate. It will serve as an important complementary model tool both for integrating different impact categories and for investigation of climate interactions. It will also link the cycling of nitrogen and base cat-ions to the carbon cycling in the forest soils.

5.2 Realisation, costs and benefits

In connection with the further negotiations on reductions of atmospheric pollutant emissions, three issues have been identified as particularly important, in addition to the results obtained through integrated assessment modelling. The issues are closely linked to the motivation of further action and form the basis of Theme 2 of the ASTA Phase II. Theme 2 will be organised in three projects that aim to answer the following questions:

2.1 What is the outcome of the measures already decided and undertaken in terms of changes in emissions, exposures as well as in environmental benefits? Have other factors (political, economic) contributed to the success of the CLRTAP protocols and will new factors become important in the future?
2.2 What are the benefits for ecosystems, of additional control measures in relation to the control costs?
2.3 How can the baseline scenarios better reflect the reality (e.g. non-technical measures)?

Questions concerning the follow-up of abatement measures, which have been undertaken, will be addressed in Theme 2, project 2.1. This work will focus on assessing if reduced emissions have had the beneficial effects in terms of chemical and biological indicators that was intended and if recovery of ecosystems has occurred as a result of reduced pollution load. Furthermore, the role of other political and economical factors in reducing atmospheric emissions will also be assessed. This includes political and economical issues such as expanding membership in EU, globalisation of energy markets etc.

Cost-benefit analysis (CBA) has become a more and more widely used tool for assessment within the environmental field. Within the EU, recommendations for standardisation of CBAs are currently underway. Recently, the Swedish EPA made an investigation of CBAs as a future area of research and development in relation to environmental policy. The experiences and outcome of that investigation will form an important background for the Theme 2 of the ASTA programme. At a CLRTAP workshop on economic valuation methods, held in the Netherlands in October 2002, the need for further research was clearly demonstrated. Theme 2 of ASTA Phase II will contribute to the improvement and development of concepts for economic quantification but also other similar valuation methods such as multi-effect analysis. A starting point for this activity is the knowledge gained on acidification and ozone effects on crops and forests. The key questions are how and if ecosystem health can be valued in monetary terms? How do we take into account different recovery rates of ecosystems at different deposition scenarios? The results should be compatible for the use in the RAINS model and other large-scale modelling/mapping tools within the CLRTAP and EU. These activities will be based on an intimate collaboration between economists (will be recruited to the programme) and natural scientists.

Further emission control strategies will take their starting point in so called baseline scenarios. The choice of baseline scenarios is likely to become critical for the outcome of air pollution strategies. They have to be actively considered by ASTA during Phase II. A baseline scenario should be a reflection of current policies against which additional policies can be evaluated. The impact and implementation of the Kyoto protocol will have to be considered in a baseline scenario along with implementation of various environmental regulations (including EU

directives) and strategies, trends in different sectors (energy, agriculture, traffic, industry) and economic activity. The time horizons chosen are also of large importance. Ultimately, gaps in environmental quality will be defined using the baseline scenario as the reference. Project 2.3 in Theme 2 will contribute to the international work in this area by evaluation of proposed baseline scenarios. A more substantial contribution will be made on non-technical measures and how these should be included in baseline scenarios.

5.3 Uncertainty, transparency and communication

The legitimacy of the agreements on reduction of transboundary air pollution becomes more important when emission reductions approach environmental target levels. Further actions will be questioned and there will be a need for more systematic analyses of uncertainties in underlying data, concepts and models. The formation of legitimacy and reliability is a multidisciplinary issue and involves aspects related to i.e. natural science, technology, economy and social science. This issue will be a main task in this sub-programme.

An important issue to deal with is the communication problems associated with the ever higher complexity of the models used within the European collaboration to reduce emissions of air pollution. It is easy to communicate that acidification is bad and that all countries should therefore reduce their emissions of sulphur by at least 30% (early 1980s perspective). Complex, dynamic multi-pollutant multi-effect strategies, such as those presently under development, are much harder to communicate efficiently to laymen and different types of stakeholders. In addition to this, uncertainties related to future scenarios relevant for the description of environmental effects are of importance. Climate change is here a main factor, which will affect atmospheric transport, deposition and processes in forest soils.

In Phase II, investigation of the uncertainties related to modelling of recovery of acidified soils and freshwaters, atmospheric deposition and formation of particles will be investigated. The work on dynamical models for recovery from acidification will focus on two areas. One is the influence of uncertainties associated with input data and the assumptions made in the model itself. The other is the uncertainties in future scenarios, which will affect model output. In the latter case, the main factors are climate change and nitrogen deposition.

The activity on atmospheric deposition will be focussed on identifying differences in modelled and measured deposition. Data from ICP forest monitoring plots will be used to evaluate output from the new EMEP model. For particles, an examination of the uncertainties of model parameterisation of formation of particles will be made.

In order to further assess uncertainties in the source-receptor modelling, the Swedish MATCH model and the EMEP Eulerian model will be run for scenarios. Results on air concentrations of NO_X, SO_2, and O_3 will be compared with measurements. Deposition of acidifying compounds will also be simulated. This activity will be performed in close co-operation with EMEP MSC-West.

The robustness of decisions in terms of the efforts (decreased emissions) needed to achieve a specified degree of environmental improvement is a key issue in this sub-programme. If optimised approaches are to be used, the solutions need to be robust in relation to how control measures are divided between countries and sectors but also in relation to the division between compounds. Solutions that lack in robustness may be difficult to get through the negotiation process.

In the social science part of this sub-programme an analysis of the sensitivity of different stakeholders, including the public, to the robustness in the environmental decision-making will be included. Who is most scared of uncertainty?

ASTA comprises one of the few scientific environments covering practically all scientific aspects of importance for integrated assessment modelling and development of strategies. We intend to make use of this situation and have a certain sub-activity with the aim to overlook all aspects of the work under CLRTAP and CAFE in relation to transboundary air pollution and contribute to the process with evaluations, suggestions for improvements, workshops for formation of con census etc.

At the end of the ASTA Phase II, in 2005, we plan to arrange an international workshop on the topic of international negotiations on complex science-based environmental issues, "Towards democratised science-based abatement strategies". The focus will be on the contributions from social scientists in order to reach more effective environmental policy instruments. We plan to invite, not only social scientists involved in research on transboundary air pollution, but also scientists, decision-makers and negotiators in the area, as well as social scientists studying climate change, an area where social scientists, due to more visible social conflicts, play an important role.

5.3.1 Communication strategy

The entire ASTA programme is directed to contribute to policy development. This means that scientific results should be communicated without any delay and in a way that they will be fully assessed in connection with policy development. The projects in the programme already to a large extent contain activities that ensure the communication. The communication will be further developed during Phase II. This development will mean both a more directed communication of progress upcoming meetings, needs and deadlines within the various bodies and a more selected communication of results.

A general knowledge of the programme and its capacity was already achieved during Phase I. Yearly reports, presentations of the programme at relevant bodies, organisation of workshops and meetings and not to forget the synthesis report has made ASTA well known in all relevant international bodies, in the international scientific community and also in many countries.

An important forum for presentation of the results of the ASTA programme Phase II will be the Acid Rain conference that will take place in the Czech Republic in 2005. ASTA participants are involved in the organisation and planning of the conference and several scientific presentations will be made by ASTA scientists.

ASTA will continue to produce yearly reports providing a summary of the progress within the project. The yearly reports will be focussed on different aspects of transboundary air pollution depending on the status of the scientific work and the policy process at the specific time of the report.

The ASTA website (asta.ivl.se) will be expanded and better equipped for downloading of reports and information about the programme. It will also include a restricted section where ASTA participants can find information on internal meetings, notes from board meetings etc.
As an important part of the final report of ASTA Phase II, a book describing the development of effect-based strategies from a natural scientific and social science perspective in planned. Although the main work of preparing this book will be during the later part of Phase II, planning will start already during 2003.

5.4 Support to national strategies

We have decided to keep the activities directly associated with development and implementation of national strategies in a separate sub-programme, mainly because national needs mostly are defined from other priorities and timeframes than the international. This sub-

programme is to a large extent a continuation of the sub-programme A2 under ASTA Phase I. Several aspects of sustainable forestry are in focus of this sub-programme. The importance of biomass removal from forests for acidification and eutrophication and for the assessment of interactions of atmospheric deposition of sulphur and nitrogen is a key issue of this activity. The potential for wood-ash recycling and compensatory fertilisation as a method to reduce impacts of acid deposition and biomass removal will also be a continued focus of these activities.

This sub-programme will to a substantial degree be broadened compared to A2 of ASTA Phase I. In order to support the revision of the national Swedish environmental quality objectives all aspects included within the ASTA programme – acidification, nitrogen deposition and it effects, ground-level ozone and fine particles – will be considered within this sub-programme.

The sub-programme is a basis for the different sector strategies concerning abatement of effects of air pollutants in Sweden. Of special interest is the relationship between local (urban) and regional (long-range transport) exposure.

6 Overall budget and funding

6.1 Budget

The programme is planned with an overall budget for the four-year period of 43.3 million SEK. Due to the very intense work within CLRTAP and CAFE during 2003 and 2004, a comparatively large part of the budget is allocated to these two years.

Table 4 Budget allocation of resources between years.

Year	**MSEK**
2003	14.4
2004	13.4
2005	9.5
2006	6.0
Sum	**43.3**

A detailed budget is made for 2003 and presented in Table 7, under point 8.

A preliminary allocation of resources between the different themes has been done and is presented in Table 5. Theme 1 will receive more money in the beginning of the programme period and Theme 2 and 3 will receive their largest support during year 2 and 3. The final decision on budgets for the different years and themes will be taken of the ASTA board.

Table 5 Allocation of resources between the themes.

Theme	**MSEK**
Theme 1	11,650
Theme 2	7,600
Theme 3	8,650
Theme 4	8,300
Administration and not allocated	7,100
Sum	**43,300**

6.2 Funding

Mistra allocated through its decision in June 33 million SEK to the programme. In addition we have discussions on additional support from the Swedish Energy Board and the National Board of Forestry as well as with the Swedish Environmental Protection Agency on additional funding and we are quite optimistic on an addition of about 10 million SEK from these sources. Most of the additional money will go to the national programme (Theme 4) but remaining themes will receive additional support.

Table 6 Funding

	MSEK
Mistra	33,000
Swedish Energy Board	4,000
National Board of Forestry	3,150
Foundation of the Swedish Environmental Research Institute	3,150
Total Sum	**43,300**

7 Compilation of Themes and projects under ASTA Phase II

7.1 Theme 1. Source- effect relationships, indicators and target setting

Co-ordinator: Håkan Pleijel

Project 1.1: Models for assessing biodiversity changes in terrestrial ecosystems
Project leader: Annika Nordin
General Objective: To develop and apply quantitative models describing the impacts of nitrogen deposition on vegetation changes in Boreal and Nemoral ecosystems.
Status: This area is currently under development. Currently used European models are not relevant to conditions in Sweden and the Nordic countries. Basic work on the development of new concepts to describe and predict vegetation changes as a function of nitrogen deposition needs to be performed. Both general models describing response of a number of plant species and model concepts based on indicator plants should be considered.
Stakeholder: WGE and CAFE
Acceptance: A large effort needs to be made on gaining acceptance of any new concepts for biodiversity predictions in Europe. Scientific evaluation and workshop
Activities: Main activities for the period 2003 to 2006 are: 1.1.1 Conceptual model development for critical loads for indicator species in Boreal forests (2003) 1.1.2 Experimental studies of lingonberry response to nitrogen deposition in nutrient-poor Boreal forests (2003-2004) 1.1.3 Experimental studies and evaluation of vegetation recovery after nitrogen load reduction (2003-2004) 1.1.4 Model development of critical load for nitrogen impact in Nemoral forests (2003-2004) 1.1.5 Testing and application of critical load model for indicator species in Boreal forests (2004) 1.1.6 Testing and application of critical load model for Nemoral forests (2003-2004)
Time constrains: New concepts and models need to be presented at latest in early 2004 to have an influence on the negotiations within CLRTAP and CAFE. In 2004 and 2005 the new models and concepts must be applied to different scenarios of N-deposition on National and European scales.
Organisation: SLU Umeå, Umeå Univ. and Lund Univ.
Co-operation: GANE - CEH (Emmet)
Main Deliverables: Model concept and test results for impacts of nitrogen deposition on vegetation diversity. in Boral and Nemoral ecosystems.
Budget 2003: 1,3 MSEK
Activities 2003: 1.1.1 Development of conceptual model for response of indicator species to deposition of nitrate and ammonia. 1.1.2 Application of critical load model for vegetation response in Nemoral ecosystems 1.1.3 Start-up year for experiments on lingonberry response in poor-Boreal ecosystems 1.1.4 Follow-up of experimental studies of vegetation recovery in experimental plots
Deliverables 2003: To be defined after the internal workshop in Dec. 2002.

Project 1.2: Dynamic models for recovery from acidification
Project leader: Filip Moldan and Mattias Alveteg
General Objective: To develop and apply dynamical models for acidification/recovery of forest soils and surface waters on the European scale
Status: Finalisation of model concepts and links to RAINS model is expected during 2003.
Stakeholder: CLRTAP-WGE, CAFE and National authorities.
Acceptance: Dynamical models for acidification/recovery are well established in the CLRTAP community.
Activities: Main activities for the period 2003 to 2006 are: 1.2.1 Finalisation of dynamical model concepts including output presentations, links to RAINS and comparability with critical load concepts for soils and freshwater. (2003) 1.2.2. Finalisation and evaluation of experimental research in the Covered Catchment project. (2003) 1.2.3 Application of dynamical models to evaluate present and future recovery of soils and surface waters in selected areas in Europe. Establish bilateral co-operation with selected countries and on-going research programmes (e.g. RECOVER). Focus on recovery process and critical load defined in activity 1.2.1 and links between chemistry in soils and surface water (2003-2005) There might be needs for additional workshops in the area and ASTA may be involved as an organiser.
Time constrains: Activity 1.2.1 and 1.2.2 to be finished by the end of 2003. Activity 1.2.3 in late 2003 and finish in 2005.
Organisation: Team of Mattias Alveteg, Filip Moldan, Liisa Martinsson, Veronika Kronnäs, Harald Sverdrup, John Munthe
Co-operation: ICP Forest, ICP Freshwaters, National Agencies, NIVA, CEH, IIASA, Univ. Virginia
Main deliverable: Model tools and concepts and their application for assessment of recovery times of soils and surface waters in selected parts of Europe.
Budget 2003: 1,3 MSEK
Activities 2003: 1.2.1 Finalisation of dynamical model concepts including output description, links to RAINS and comparability with presently used critical load concepts for soils and freshwater. (2003) Further development of presentation techniques for the dynamical model outputs based on modelling work in ASTA phase 1. Work with multiple future scenarios. Further work towards compatibility of the DM outputs with RAINS model by calculating e.g. target load functions. 1.2.2. Finalisation and evaluation of experimental research in the Covered Catchment project. (2003) Completion of two years long follow-up monitoring of the Covered Catchment after the roof was removed in summer 2000. Evaluation of the experimental data. 1.2.3 Application of dynamical models for recovery soil and surface waters in selected areas in Europe. Establish bilateral co-operation with selected countries and on-going research programmes (e.g. RECOVER). Focus on recovery process and critical load defined in activity 1.2.1 and links between chemistry in soils and surface water (2004-2005) Developing contacts with national research groups involved in dynamic modelling of future status of soils and surface waters. Taking part in their efforts and synthesising the results.
Deliverables 2003: D 1.2.1a Report from the 3rd JEG meeting in Sitges 2002 D 1.2.1b Report on methodology for coupling of dynamical models SAFE and MAGIC to RAINS and examples. D 1.2.2 Final report of Covered Catchment project: 14 years of experimental research on recovery. D 1.2.3 Report on modelling of European surface waters at selected sensitive areas including Sweden (ASTA and RECOVER:2010 project)

Project 1.3 Implementing level II for ozone
Project leader: Håkan Pleijel and Per Erik Karlsson
General Objective: To finalise the development of flux-response relationships for crops and forest trees and the derivation of critical levels from these To actively support the implementation of the new critical levels for ozone in the negotiations on a European level
Status: there will be an important workshop in Sweden November 2002 where the direction of future work will be discussed in detail (organised by ASTA); important implementation work expected in 2003-early 2004
Stakeholder: WGE CCE, ICP Vegetation, ICP Forests,
Acceptance: Level II models based on leaf/needle ozone uptake is the main candidate for a new concept in this filed although several approaches are possible within the frames of this concept.
Activities: 1.3.1 Finalisation and scientific publication of Level II model concepts and methodologies for ozone impact on crops and forests (2003). Quantitative examination of the possible effects of open-top chamber enclosure on the dose-response relationships between ozone exposure and growth effects (2003). 1.3.2 Method validation, field validation and support to experimental work. Includes support to, and participation in, field validation activities (Karlstad University, SLU Asa (forest) and an agricultural experiment site (crops)) (2003) 1.3.3 Contribution to assessment of ozone impact and critical levels for forests on European scale for the preparation of background material for the renegotiation of the Göteborg protocol and for the café programme (2004). 1.3.4 Contribution to assessment of ozone impact and critical levels for crops on European scale for the preparation of background material for the renegotiation of the Göteborg protocol and for the café programme (2004).
Time constrains: Modelling tool/concept to be finished during 2003.
Organisation: IVL and GU
Co-operation: Botan, Asa, Karlstad, Finland, "Hushållningssällskapet" and certain other research groups in several European countries, which contribute data to the European scale analyses performed within ASTA for crops and forest trees
Main Deliverable: Ozone Level II model, including stomatal conductance models and evaluations of the open-top chamber technique, and assessments of ozone impact on crops and trees on National and European scales:
Budget 2003: 1,2 MSEK
Activities 2003: - Final calibration of ozone uptake based dose-response relationships for wheat, potato, spruce and birch under Swedish conditions - Final calibration of pan-European, ozone uptake based dose-response relationships for wheat, potato and several tree species in active collaboration with scientist outside Sweden - Field validation of stomatal conductance models for spruce, birch and wheat - Analysis the effects the open-top chamber exposure technique based on existing data from the Östad field station Active contribution to the process within LRTAP by direct contacts with modellers and mappers and by visiting important meetings and workshops.
Deliverables 2003: D 1.3.1a Report on model concept and application for ozone impact on crops. D 1.3.1b Report on model concept and application for ozone impact on forest trees. D 1.3.1c Report on the effects of the open-top chamber technique D 1.3.2a Report on field validation of conductance model for wheat D 1.3.2b Report on field validation of conductance model for Norway spruce and birch (results from Karlstad University) and the Botanical Inst. GU). D 1.3.2c Report on field validation of ozone impact on spruce (results from SLU Asa,)

Deliverables 2004:
D 1.3.1d Final report on methodology for Level II assessment of ozone damage to crop yield, including some yield quality aspects.
D 1.3.1e Final report on methodology for Level II assessment of ozone damage to forest trees.

Project 1.4 Source-receptor relationships for long range transported particles
Project leader: Hans-Christen Hansson
General Objective: To establish the primary reference on particle composition and origin in background air over N Europe to support model development and health risk assessment
Status: Regional monitoring of particles is today limited to simple parameters (e.g. PM10). Scientific understanding and model development needs a much more detailed description of composition and its variation in time and space. ASTA has initiated and supported such measurements in background air and also encouraged collaboration between the modelling and monitoring communities in order to improve data quality and model performance.
Stakeholder: EU CAFE working group on particles. EMEP: TFMM, MSC-W and CCC.
Acceptance: Health effects from particles is a main topic for the EU CAFÉ programme and there is a large political interest for a co-ordinated European policy.
Activities: Measurements will go on for some time during the second phase but then most of the efforts will be concentrated to data evaluation and synthesis. 1.4.1 Continued field studies of composition of atmospheric aerosols in rural air. 1.4.2 Evaluation of data with respect to particle composition and origin. 1.4.3 Establishment of a database for further evaluation and model development/validation. 1.4.4 Participation in international expert groups on particle composition, monitoring and assessment. 1.4.5. Expert support to EMEP model development and validation.
Time constrains: EMEP needs to have model on particles by which source receptor relationships can be established before the autumn 2003.
Organisation: ITM and Lund University
Co-operation: Norwegian Meteorological Institute (MSC-W), Norwegian Institute for Air Research (NILU), Technical University, Helsinki,
Main Deliverable: Evaluation of the module on particles in the EMEP model. PhD thesis. (Peter Tunved). Characterisation of the background aerosol over N Europe. Data set on particle size distributions, chemical composition, solubility and phenology of particles. PhD thesis (Adam Kristensson). Support to EMEP model development with data for development and validation.
Budget 2003: 1,5 MSEK
Activities 2003: 1.4.1 Continued studies of composition and transport of particulate air pollution over Scandinavia. 1.4.2 Support to development and validation of models.
Deliverables 2003: D 1.4.1 Minimum three scientific papers on composition and origin of particles in Scandinavia D 1.4.2 Support to model development and validation through studies of changes in atmospheric composition during transport over Scandinavia.

Project 1.5 Development of a dynamic model for the assessment of combined ecosystem effects
Project leader: Harald Sverdrup
General Objective: To develop a customised model for the assessment of the combined ecosystem effects of regional air pollution (acidification, N deposition, particles, and ozone), climate and land use practices.
Status: A number of basic concepts have been suggested and tested on a research basis in Netherlands and Sweden, but no operational system is available. Parameterisation methods and data exists for some experimental plant groups, but many important types are not yet represented. Full integration of the dimensions (1) nitrogen, soil water, temperature. An existing prototype has been tested in the Netherlands, but no parameterisation is yet available for Scandinavian conditions.
Stakeholder: European National Focal Centres for mapping critical loads for sulphur and nitrogen under the CLRTAP UN/, WGE, CAFE, Swedish forest management research; HEUREKA, SUFOR, Swedish Agricultural University colleagues
Acceptance: Within the effects assessment groups within ECE and IIASA, effects modules are very much demanded. A large effort needs to be made on gaining acceptance of any new concepts for vegetation predictions in Europe among people in basic research.
Activities: The detailed plan of this project will be made in the first quarter of 2003. Activities related to combined effects of nitrogen and ozone will be started in 2003. Planned activities for the period 2003 to 2006 are: Model development: 1.5.1 Programming of the conceptual models derived for indicator species in project 1.1Parameterisation of plant group properties and response functions based on published dose-response relationships The vegetation response package will be included into the existing FORSAFE model A regional input database will be developed and test runs on sites and subregions will be made (2003) Model use: Preliminary assessment of critical loads for nitrogen using the model (end of 2003 into 2004), using the 650 SAFE sites Use of the FORSAFE-VEG model regionally in Sweden (2003-2004) Transfer of the FORSAFE-VEG model into Europe (2004), test on ICP-Forest sites and national critical loads databases used for dynamic assessment. Climate and forest management scenarios (2005-2006) Sustainability aspects in a wider sense (2006)
Time constrains: New concepts and models need to be presented at latest in early 2004 to have an influence on the negotiations within CLRTAP and CAFE. In 2004 and 2005 the new models and concepts must be applied to different scenarios of N-deposition on National and European scales.
Organisation: Lunds Universitet, SLU Umeå, Umeå Univ., Lund Univ. Key persons; Harald Sverdrup, Torny Näsholm, Han van Dobben, Wim de Vries
Co-operation: Alterra Green World Institute Nederländerna
Main Deliverables: Model concept, operational model and test results for impacts of nitrogen deposition on ground vegetation aspects, diversity in European terrestrial ecosystems, where variability in climate, acidification status and forest development effects also have been considered.
Budget 2003: 350 kSEK
Activities 2003: 1.5.1 Development of a modell on ozone effects. 1.5.2 Development of a modell on nitrogen effects (will continue into 2004).
Deliverables 2003: D 1.5.1 Status report on programming and testing of the conceptual model for indicator species.

7.2 Theme 2. Realisation, costs and benefits

Co-ordinator: John Munthe

Project 2.1: Realisation of international agreements and their effects on emissions, exposures and ecosystems
Project leader: Gun Lövblad and NN
General Objective: The objective is to follow-up and to evaluate the result of the earlier protocols and undertaken measures. This project also aims to support the assessment report of EMEP's monitored and modelled data.
Status: The outcome of control measures in order to control European air pollution emissions so far is not well studied. ASTA took a couple of years ago the initiative to an all-European assessment of the development of emissions, atmospheric concentrations and deposition over Europe during the more than 20 years' of EMEP. The initiative has now developed to a main task for the TFMM and a large number of countries are today involved in making their own assessments. The final assessment report will be available in 2004. There is still a large lack in knowledge to what extent protocols and other international agreements have caused the emission reductions in transboundary air pollutants and to what extent there are other causes. Information on these issues is considered as important for our understanding on how other environmental forces and structural changes in the society may interact with environmental agreements exclusively directed towards transboundary air pollution.
Stakeholder: WGE, CAFE, EMEP, TFMM, European countries etc.
Acceptance: To gain acceptance for future international negotiations it is necessary to follow-up the outcome from previous agreements and to verify the data quality.
Activities: Main activities for the period 2003 to 2006 are: 2.1.1 Assessment work on monitored and modelled data. ASTA organises the assessment work on the 20 years time series of data provided by EMEP. The work started in 2002. 2.1.2 Evaluation the role of the international protocols on emission reductions including the relative importance of different measures, the status of the protocols as driving force and the effect of globalisation of e.g. energy markets. (2003-2005)
Time constrains: The assessment work will be reported 2004.
Organisation: IVL, GU
Co-operation: IIASA, EMEP
Main Deliverables: EMEP Assessment report to be delivered to EMEP Steering Body in September 2004.
Budget 2003: 500 kSEK
Activities 2003: 2.1.1 Co-ordination of the EMEP Assessment Report 2.1.2 Production of preliminary texts for chapters on countries and on the situation in N Europe.
Deliverables 2003: D 2.1.1 Co-ordination of the work. Progress reports to EMEP Steering Body and TFMM.

Project 2.2: Valuation of effects

Project leader: Catarina Sternhufvud

General Objective: To evaluate economic and other benefits for ecosystems etc. of additional control measures for air pollutants in relation to the control costs.

Status: Cost Benefit Analysis has become a more widely used tool for assessment within the environmental field, both international as well as national. Knowledge on how to value biologic diversity and how to incorporate the dynamic processes are still underdeveloped.

Stakeholder: WGE, WGS, CAFE and Swedish Environmental Protection Agency.

Acceptance: Within the EU, recommendations for standardisation of CBAs are currently underway. The Swedish EPA has carried out an investigation of CBAs as a future area of research and development in relation to environmental policy.

Activities: Main activities for the period 2003 to 2006 are:
2.2.1 Creation of a detailed programme plan for theme 2. Including defining scientific approach to be used in duration of ASTA Phase 2 and networking with national/international actors. (2003)
2.2.2 Improvement of the concepts of economic valuation. Evaluation of which benefits can be valued in economic terms and for which other indicators are needed. Assessment of current valuation methods for air pollution effects and refining to include dynamical aspects of effect/recovery of ecosystems. Possibilities and difficulties with benefit transfer will also be further discussed. (2003-2005)
2.2.3 Assessing costs and benefits of reduced emissions for acidification and ozone effects on crops and forests. The calculations will be based on results from ASTA phase I and Theme 1 and might include valuation studies (2003-2006).
2.2.4 Take part in a workshop on "Costs and benefits of the implementation of abatement strategies against transboundary air pollution". (2005)

Time constrains: Results from this project have to be presented mainly during 2005 to have an influence on the review of the protocols within CAFE and CLRTAP.

Organisation: IVL, GU, LU

Co-operation: IIASA, Swedish Environmental Protection Agency

Main Deliverables:

- Reports on improvements of the concepts of economic valuation of the environment.
- CBA for acidification and the recovery of the environment.
- CBA for ozone effects on crops and forests.
- Conclusions from the Workshop on CBA.

Budget 2003: 1 MSEK

Activities 2003:
2.2.1 The first task for 2003 is to create a well working network for theme 2, both national and international, which will include a new environmental economist. The scientific approach that will be used under ASTA phase II will be formulated within this network and a detailed plan will be presented.
2.2.2 The work on how to improve the concept of economic valuation will start during 2003. A project dealing with how to value different effects in monetary terms will carried out and the work with how to take into account dynamic effects in CBA will start.

Deliverables 2003:
D 2.2.1 A deepened programme plan for theme 2.
D 2.2.2a Report on which effects that can be valued in monetary terms and ought to be included in the CBAs.
D 2.2.2b Journal paper on how to include the dynamic process in CBA.

Project 2.3: Scenarios and non-technical measures
Project leader: Catarina Sternhufvud
General Objective: To support the validation process of the baseline scenarios used in CAFE and CLRTAP, using non-technical measures as a starting point.
Status: The choice of baseline scenario is likely to become critical for future environmental strategies including air pollution, and all countries in the Convention are requested to give feedback and input to the scenarios created at IIASA. The use of non-technical measures in the baseline scenarios and in the cost curves has become more important due to their importance for the climate change as well as for other air pollutants.
Stakeholder: WGS, CAFE, TFIAM, Swedish EPA
Acceptance: Validation of the baseline scenarios are essential for the credibility of their use. The use of non-technical measures in the scenarios or in the cost curves are slowly becoming accepted also for reduction of transboundary air pollution.
Activities: Main activities for the period 2003 to 2006 are: 2.3.1 Assessments of the scenarios used on the international arena and support to the validation of the baseline scenarios. (2003-2004) 2.3.2 Valuation of non-technical measures and increase the use of non-technical measures in international negotiations. (2003-2005)
Time constrains: Input to the scenarios created at IIASA has to be provided during 2003-2004 and the validation of their proposed scenarios need to be carried out during 2004.
Organisation: IVL, Swedish EPA
Co-operation: IIASA
Main Deliverables: • Report on consequences of the choice of baseline scenarios. • Report on possible measures to be included in the international scenarios or cost curves.
Budget 2003: 700 kSEK
Activities 2003: 2.3.1 Initial work on assessment of baseline scenarios. IIASA will create the baseline scenarios during 2003. The support to the validation process of these scenarios will start as soon as they have been sent out to the countries in the Convention. Evaluate possibilities and methods for including non-technical measures. 2.3.2 Initial work on valuation of non-technical measures. ASTA will participate in the workshop in Vienna in January 2003 that will deal with this question. Overview of non-technical measures and available cost estimates will be performed.
Deliverables 2003: D 2.3.1 Paper on possible non-technical measures to be included in the international scenarios or cost curves.

7.3 Theme 3. Uncertainties, transparency and communication

Co-ordinator: Peringe Grennfelt

Project 3.1: Scientific credibility in a complex society
Project leader: Göran Sundqvist
General Objective: To evaluate the influence of uncertainties and scientific credibility on the process of international agreements on emission control
Status: During the first phase, knowledge has been created on science-policy relation in the development of LRTAP Convention up to today. However, in this phase attention is devoted to the future revision of the Gothenburg protocol and EU directives for transboundary air pollution.
Stakeholder: The scientific community involved in the LRTAP work
Acceptance: Knowledge on how science interacts with policy is still underdeveloped. With the introduction of new concepts and models in the international regulation it is of great importance to gain knowledge on how science and policy interact, communicate and influence each other. Stakeholders have demanded an assessment of uncertainties in the revision of the Gothenburg protocol and the NEC directive. EU is requiring more transparency in the work of expertise in order to increase the credibility of expert knowledge. A close collaboration between the social science and the natural science expertises in ASTA may facilitate further interactions between science and policy in CLRTAP and CAFE communities.
Activities: 3.1.1 Evaluation on how uncertainties are managed and utilised by different stakeholders in the policy process (2003). In 2004 results from this activity will be developed in a study together with project 3.2 on the possible connections between the policy actors' view on uncertainties and how scientists calculate uncertainties in source effects relationship (Harald Sverdrup, Lars Lindau). 3.1.2 A study on how scientific experts try to establish the concept of recovery in the IAM work and in the policy process (to be developed together with project 1.2 – IVL, LU) (2003-2004). 3.1.3 A study of the social process of standardisation and negotiation (within CLRTAP/EMEP and EU/CAFE) related to long-distance transport of particles and their health impacts (2003-2004). Links to project 1.4 and 1.5 and activity 3.3.5 (HC Hansson). 3.1.4 A study on how to integrate scientific and public assessment in environmental regulation in the LRTAP field (co-operation with Örebro University and Lancaster University). 3.1.5 The development of a new classification model on the science-policy interface in the LRTAP field (co-operation with IVL)
Time constrains: The knowledge gained is important for the work in introducing new concept and models in the preparation for the negotiations within LRTAP and CAFE.
Organisation: Göteborg University (Göran Sundqvist, Rolf Lidskog, Martin Letell), IVL Peringe Grennfelt
Cooperation: Lancaster University (Centre for the Study of Environmental Change), Örebro University (Centre for Urban Research/Centre for Man-Technology-Environment),
Main Deliverables: Letell, Martin (2004) *On the Limits of Negotiation? Health, Particles and Transboundary Air Pollution* (diss.) Sundqvist, Göran & Lidskog, Rolf (2005) *Scientific Knowledge, International Politics and National Implementations: The case of transboundary air pollution* (monograph) Papers in international scientific journals
Budget 2003: 800 kSEK
Activities 2003: (See deliverables for 2003)

Deliverables 2003:
D 3.1.1 A report on the management of uncertainties in the policy process of LRTAP report from project 3.1.1)
D 3.1.5 A paper on the development of a new classification model on the science-policy interface in the LRTAP field (final report from project 3.1.5)
D 3.1.2 A paper on the work to establish the concept recovery in the IAM work (report from project 3.1.2)
D 3.1.4 A paper on the condition for integrating stakeholders in environmental regulation (report from project 3.1.4)

Project 3.2 Uncertainties in source effects relationships
Project leader: Peringe Grennfelt (Mattias Alveteg, Filip Moldan, Veronika Kronnäs, Joakim Lagner, HC Hansson, Erik Swietlicki, Olle Westling)
General Objective: To evaluate the uncertainties in key models of importance in international agreements on emission control
Status: The need for assessing uncertainties in source-effect data is large. Any form av assessment of uncertainty needs to be based on scientific data. Uncertainty assessments will be needed in connection with the development of abatement scenarios.
Stakeholder: TFIAM, WGSR, WGE, EMEP, Industry, NGOs,
Acceptance: Policymakers and stakeholders have requested that uncertainties should be assessed in connection with the revisions of the Göteborg Protocol and the NEC directive.
Activities: 3.2.1 Uncertainties in measured and modelled deposition values in Europe. Data from ICP Forest sites will be used together with EMEP monitoring data to assess the uncertainties in output from the EMEP 50x50 km model. (2003) 3.2.2 Determining model uncertainties in predictions of recovery from acidification with dynamic models MAGIC and SAFE and their influence on control strategies. Focus will be on uncertainties related to model input data and parameterisation of main processes in model (2003-2004). Furthermore, impacts of future scenarios of e.g. climate change will be investigated. 3.2.3 Uncertainties in source-receptor relationships for particles due to model formulation and input data (2003-2004) 3.2.4 Support to EMEP MSC-West - Assessment of uncertainties in Eulerian model. The MATCH model will be run by SMHI and model output from MATCH and the EMEP Eulerian model will be compared with measured concentrations and fluxes. The results will be used to assess uncertainties of the EMEP model and to suggest further improvements.
Time constrains: Data need to be available in 2004 (CAFE) or 2005 (CLRTAP)
Organisation: The work will be carried out by IVL, SMHI, LU Chemical Technology, SLU MA.
Co-operation: IIASA, CCE and MSC-W
Main Deliverables: An assessment of the uncertainty of models describing recovery of acidified soils and freshwaters, atmospheric deposition of pollutants, source-receptor relationships for and formation of particles.
Budget 2003: 1,280 MSEK
Activities 2003: Evaluation of deposition data from the ICP Forest Level II network. Model runs on source receptor relationships with the MATCH model. Model runs on uncertainties in recovery.
Deliverables 2003: D 3.2.1 Assessment of uncertainties in EMEP model deposition D 3.2.2 Preliminary assessment of uncertainties in dynamical models of recovery of sols and surface waters. D 3.2.3 Status report on uncertainty of source-receptor relationships for particles D 3.2.4 Status report on MATCH/EMEP model assessment work.

Project 3.3 Communication
Project leader: Peringe Grennfelt
General Objective: Ensure a customer-oriented and timely communication between ASTA and policy-relevant bodies and communities under CLRTAP, EU and other international organisations.
Status: The success of ASTA in terms of policy support depends strongly on the ability to customise and deliver the scientific material on time. Much of the material of importance for IAM must be delivered during 2003 or the first half av 2004 and there is a need that new concepts, manuals and data are available in time. There is also a continued need for material even after that material should have delivered for IAM and strategy development purposes. ASTA has a strong interaction with the various bodies under CLRTAP and may be able to meet most requirements. Problems may however occur with respect to the data on effects of N deposition. The decreased interest in transboundary air pollution in Europe may cause problems at negotiations. Other problems may be considered more important. Communication may therefore have the capacity to be visible in the general noise.
Stakeholder: All bodies under CLRTAP, EU organisations, industrial organisations, NGOs, Politicians
Acceptance: Many stakeholders, policy makers and the general public do not consider transboundary air pollution as a remaining environmental problem.
Activities: 3.3.1 Establish a communication strategy and platform with the aim to ensure a simple and cost-efficient communication between ASTA and policy-related bodies. An Intranet will be established where all information on meetings and deliverables will be available. Short reports from meetings will also be displayed on the Intranet. 3.3.2 Workshop: A second overall strategy workshop will be held in 2004. It will be a follow-up of the workshop in Saltsjöbaden 2000 and all bodies involved in the process will be invited as well central scientists and stakeholders. The objective is to set the scene for negotiations and to identify areas of common understanding as well as areas where there still are uncertainties and/or different opinions. 3.3.3 Workshop: "Democratised science-based abatement strategies" 2005. 3.3.4 Annual reports and ASTA website. ASTA is requested to produce yearly reports. 3.3.5 Participation in the preparation of CAFE Position paper on particles. Organisation of a Workshop on the position paper in June 2003. CAFE WG PM. 3.3.6 Book describing environmental effects of air pollutants and how these have been dealt with in international agreements on emission control. Science and policy discussions. The book should be considered as a final report and a testimony of ASTA. 3.3.7 Other activities which will identified by the ASTA board.
Time constrains: The schedule and deadlines for deliveries are very tight and definite and material not available on time may be without consideration in the further process.
Organisation: IVL and to some extent all the participants in the programme
Co-operation: The Mistra secretariat, Swedish Environmental Protection Agency, UNECE secretariat, Nordic Council of Ministers, EU CAFE etc.
Main Deliverables: Yearly reports. Workshops and workshop reports. Dissemination strategies and customised communications with policymakers, stakeholders and the public.
Budget 2003: 750 kSEK
Activities 2003: Development of the webpage to include relations to ongoing international activities. Yearly report.
Deliverables 2003: Yearly report Workshop report from workshop on particles.

Project 3.4 Overall development and evaluation of regional air pollution strategies
Project leader: Peringe Grennfelt
Objective: Support the overall scientific work on strategies for regional air pollution.
Status: The upcoming strategies will contain several improvements in all compartment models and databases. There is a need to closely follow and evaluate the new concepts and models in terms of their scientific basis as well as in their ability to give results that are in accordance with the overall expectations. This activity aims to take a global view on all aspects of importance for the IAM strategies.
Stakeholder: CLRTAP, EU CAFE, National experts, Industry, Scientific community TFIAM
Acceptance: The acceptance of the chosen concepts and model approaches will very much depend on evaluations and assessments (E&A) of IAM compartments as well as the overall IAM. This project aim to support the E&A process.
Activities: 3.5.1 Examination of the overall approaches in the IAM for CAFE and CLRTAP. If necessary putting forward proposals for improvements. Participation in the work within TFIAM. 3.5.2 Specific evaluations of the outcome of different IAM calculations
Time constrains: Main activity in 2004 and 2005
Organisation: IVL
Co-operation: IIASA, NEPAP network
Main Deliverables: Assessment report on the concepts used Final report on how new concepts have changed objectives and outcomes of regional air pollution strategies.
Budget 2003: 200 kSEK
Activities 2003: To be decided together with the ASTA board.
Deliverables 2003: Depends on the progress of the IAM work. Probably only a status report.

7.4 Theme 4 Support to national strategies

Co-ordinator: Olle Westling
Total budget: 8 300 kSEK

Stakeholders and funding agencies: National Board of Forestry, Swedish Energy Agency, Ministry of Environment
Since this activity will depend on external funding it is not described in the same details as the remaining themes.

Project 4.1: Natural acidification only
Project leader: Olle Westling
General Objective: To develop methods and tools for assessment of acidification of soils and surface water with different scenarios for deposition and forest management, including harvest of forest fuels (slash removal).
Main Deliverables: • Tools for scenario analysis of acidification of forest soils. • Regional study of acidification and recovery with different scenarios for forest management. • Support to following up the objective "Natural acidification only".

Project 4.2: No eutrophication
Project leader: Cecilia Akselsson
General Objective: With the use of scenarios assess the impact of different intensity in forestry on the future risk of accumulation and increased leaching of nitrogen from forest soils in Sweden.
Main Deliverables: • Tools for scenario analysis of the cycling of nitrogen in forest soils. • Regional study of accumulation and leaching with different scenarios for forest management. • Support to following up the objective "No eutrophication".

Project 4.3. Limited influence on climate
Project leader: Olle Westling
General Objective: Estimation of carbon sequestration, with scenarios describing different nitrogen deposition and forest management, based on the calculations of nitrogen accumulation in forest soils in Sweden.
Main Deliverables: • A regional study of carbon sequestration with different nitrogen deposition and forest management.

Project 4.4. Clean air
Project leader: Per-Erik Karlsson/ Olle Westling
General Objective: Support to i) calculations of the contribution from combustion of biofuels to the emissions of particles to air in Sweden. ii) apply new methods to calculate growth reductions of crops and trees in Sweden, caused by surface ozone.
Main Deliverables: • Support no a national mapping of emissions of particles to air from combustion of biofuels. • Support to a national mapping of growth reductions of crops and trees in Sweden, caused by surface ozone.

Project 4.5: Tools and databases
Project leader: Cecilia Akselsson/ Olle Westling
General Objective: Support to the different activities of Theme 4 in developing tools and databases for regional model calculations and scenario activities.
Main Deliverables: • A user-friendly tool for regional mass balance calculations of nutrients in forest soils. • Tools for identifying the need for compensatory fertilisation after whole tree harvest. • National database with land use and complementary data. • Data on weathering with high resolution in Sweden.

Project 4.6. Communication of results
Project leader: Olle Westling
General Objective: Communication with stakeholders to identify relevant case-studies and scenarios. Dissemination of results as a basis for strategic decisions in different sectors and following up of environmental objectives and targets.
Main Deliverables: • Seminars/workshops with stakeholders. • Special reports and evaluations initiated by stakeholders. • Scientific papers and a doctoral thesis, “Interactions between Air Pollution and Forest Management – Tools for Regional Assessment and Predictions of Acidification and Eutrophication Effects”.

8 Proposed budget for 2003

The proposed budget for 2003 is 12 MSEK. The detailed budget for Theme 1-3 and projects under these Themes is presented in Table 7. For some of the projects, the budget has not been specified in terms of which ASTA partner will carry out the work. In some of these cases, additional planning and co-ordination with international activities is necessary before decisions on the final work-plan can be made. In other cases it is more a question of dividing the work between ASTA partners.

Table 7 Preliminary budget for 2003.

Activity	**Participating organisations**	**2003 kSEK**
1. Source-effect relationships, indicators and target setting		
1.1 Models for assessing biodiversity changes in terrestrial ecosystems	**UU, SLU U, LU E, LU K**	**1300**
1.2 Dynamic models for recovery from acidification	**LU K, IVL**	**1300**
1.3 Implementing level II for ozone	**GU M, IVL**	**1200**
1.4 Source-receptor relationships for long range transported particles	**LU F, ITM**	**1500**
1.5 Development of a dynamic model for the assessment of combined ecosystem effects	**LU K, IVL**	**350**
2. Realisation Costs and Benefits		
2.1 Realisation of international agreements and their effects on emissions, exposures and ecosystems	**IVL**	**500**
2.2 Valuation of effects	**IVL GU**	**1000**
2.3 Scenarios and control measures	**IVL**	**700**
3. Uncertainties, transparency and communication		
3.1 Scientific credibility in a complex society	**GU S and others**	**800**
3.2 Uncertainties in source effects relationships and their influence on abatement strategies	**LU K, GU M, SLU MA, SMHI, IVL**	**1280**
3.3 Communication	**IVL GU S and others**	**750**
3.5 Overall development and evaluation of regional air pollution strategies	**IVL,**	**200**
4 Support to national strategies	**LU K, IVL**	**2375**
Co-ordination/administration	**IVL**	**700**
Reserve		**400**
Total Sum		**14355**

Explanations to Table 7:
UU = Umeå University; SLU U = Swedish Agricultural University Umeå; LU E = Lund University Department of Ecology; LU K = Lund University Chemical Technology; LU F = Lund University Nuclear Physics; IVL = Swedish Environmental Research Institute; ITM = Institute of Applied Environmental Sciences; GU M = Göteborg University Environmental Sciences; GU S = Göteborg University Social Sciences; SLU MA = Swedish Agricultural University Environmental Assessment; SMHI = Swedish Meteorological and Hydrological Institute

9 Abbreviations

ASTA	International and National Abatement Strategies for Transboundary Air Pollution
CLRTAP	Convention on Long-Range Transboundary Air Pollution
CAFE	Clean Air For Europe (EU)
CCE	Coordination Centre For Effects (CLRTAP)
WGE	Working Group on Effects (CLRTAP)
WGS	Working Group on Strategies
EGAc	Expert Group on Acidification (CLRTAP)
ICP	Integrated Cooperative Program. Vegetation, Crops, Forests etc (CLRTAP)
TFMM	Task Force on Measurements and Modelling (CLRTAP)
MSC-W	Meteorological Synthesising Centre West (CLRTAP)
EMEP	Cooperative programme for monitoring and evaluation of the long range transmission of air pollutants in Europe (CLRTAP)
CCC	Chemical Coordination Centre (CLRTAP)
TFIAM	Task Force on Integrated Assessment Modelling (CLRTAP)
CIAM	Centre for Integrated Assessment Modelling (CLRTAP)
JRC	Joint Research Centre (EU)
IAM	Integrated Assessment Modelling
EEA	European Environmental Agency (EU)
RESE	Remote Sensing for the Environment (Mistra)
LUSTRA	Land Use Strategies for Reducing Greenhouse Gas Emissions (Mistra)
SUFOR	Sustainable Forestry In Southern Sweden (Mistra)
UN ECE	United Nations Economic Commission for Europe
NEGTAP	National Expert Group on Transboundary Air Pollution: Acidification, Eutrophication and Ground-Level Ozone in the UK
IIASA	International Institute for Systems Analysis
FIMCI	Forest Intensive Monitoring Coordinating Institute (EU)
HEUREKA	(Mistra)
NGOs	Non-Governmental Organisations

10 References

Munthe J., Grennfelt P., Sverdrup H. and Sundqvist G, "*New concepts and methods for effect-based strategies on transboundary air pollution*" ASTA Synthesis Report, April 2002, IVL Report B1495