Sida Evaluation 04/16

The Asian Regional Research Programme in Energy, Environment and Climate – ARRPEEC

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Department for
Research Cooperation

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Executive Summary

1. Programme purpose, components and location

The Asian Regional Research Programme in Energy, Environment and Climate, ARRPEEC, was initiated in 1993 to enhance understanding of Energy-Environment-Climate issues, improve the expertise of researchers and provide opportunities for National Research Institutes (NRIs) in the region to work together in a network. The aim was further to enhance policy-oriented research capacity, including among younger researchers.

The Programme is managed and co-ordinated by the Energy Programme of the School of Environment, Resources and Development at the Asian Institute of Technology, (AIT), in Bangkok, Thailand. The Programme has received programme support from Sida for three consecutive phases, Phase I 1995–98, Phase II 1999–2002, and Phase III 2002 to the present but not yet fully reported on. The initial Phase of the Programme, 1994–97, was evaluated by Christensen and Mackenzie (1998)[0].

The initial four research projects or themes were slightly changed for the second Phase of the Programme and the participating NRIs altered, partly as a result of the 1998 evaluation. The changes between Phase II and III were mainly due to an evolution towards a more policy-oriented research approach. The themes during Phases II & III were:

- Small- and medium-scale industries in Asia: energy, environment and climate interrelations;
- Mitigating environmental emissions from the power sector: analysis of technical and policy options in selected Asian countries;
- Analysis of technical options for mitigating environmental emissions from the urban transport systems in selected Asian countries; and
- Biomass energy in Asia: a study on selected technologies and policy options.

Part of the research strategy and capacity improvement has also been addressed through a Fellowship Programme that has been administrated and co-ordinated by AIT. The research fellows, mainly nominated by NRIs, carried out their training or research at AIT.

2. Purpose and focus of the evaluation

This evaluation addresses the issues below but it is important to stress that although it is inevitable that various observations and criticisms will be made in any evaluation, Phases II and III of this Programme were mainly of very high quality and carried out with a commendable level of professional competence. The method of evaluation involved reference to the initial programme specifications and objectives and an assessment, from the documentation provided, of how far the objectives had been attained and developed. There was little opportunity to discuss the output with members of the research team directly although there was some communication between the evaluators and the researchers by Email.

[0] Christensen, J,M, & Mackenzie (1998). The Asian Regional Research Programme in Energy, Environment and Climate. Sida Evaluation 98/12. Swedish International Development co-operation Agency, Stockholm

The issues addressed in the evaluation were:

- How far and how well ARRPEEC has addressed the issue of GHG mitigation in the Asian countries involved in it including the validity and feasibility of GHG mitigation strategies and policies arrived at by ARRPEEC.
- The contribution of the Programme to the strengthening of research and analytical capacity in the energy-environment-climate interface at the NRIs as well as at AIT including improvements in the capacity to address issues and potential obligations under the UNFCCC and the Kyoto Protocol.
- The quantity and quality of the Programme outputs including the modes of dissemination, and the appropriateness of the networking character of the Programme.
- The cost-effectiveness of the Programme, in broad terms, compared with other relevant regional programmes.

The evaluation should further recommend changes in the ARRPEEC approach and programme appropriate to enhancing the capacity to address activities proposed by the IPCC for a transition into a situation of post-stabilization of GHG emissions. These recommendations should aim at assisting the transformation of ARRPEEC into a regional Climate Change Research Programme addressing climate change problems and the undertakings under the UNFCCC and the Kyoto Protocol for the region.

3. Programme evolution towards policy orientation

Of the four themes that constituted the Programme during the initial phase three were further developed in Phase II, the Biomass Energy project, the E^3ST for industries into small- and medium-sized Industries, and the Electricity Sector project into a Power Sector project. The Urban Transport Sector project replaced a project on Polycyclic Aromatic Hydro-carbons that was mainly subsumed into the Biomass project.

This alteration and redirection of themes was partly the result of the 1998 evaluation. The Programme, as a result, also reflects the need for stronger links between the themes, all of them now addressing the energy-environment-climate interface both in a more local perspective and as an important contribution in GHG mitigation and thus climate change. Within all the projects the second phase was used to identify energy efficient and environmentally friendly technologies that would result in less GHG and other hazardous gases emissions, thus presenting more environmental and climate friendly viable options for the four sectors. The selection of project themes on small- and medium-sized industries and on the urban transport sector is appropriate from a GHG mitigation perspective as the small- and medium-scale utilization of fossil fuels for energy production in power, industry and households, as well as for transportation, is important.

The four projects in evolving from the Phase II to the Phase III, from research on technical options to policy-oriented research are evolving in an important and appropriate direction. However, the evaluating team considers this step to be the weakest part of the Programme. Obviously, the methodology used, both to identify a policy strategy to achieve the best possible options, to identify and classify the barriers towards the introduction of these options and the measures to overcome the barriers is not fully viable. Most of the results achieved so far are too meagre to be scientifically justified or are unable to be implemented. An important reason for this is the lack of involvement of social scientists or policy- and decision-makers. Unless policy-makers are involved, as partners, at an early stage, possibilities of implementing the results of the analysis of options are very small.

4. Programme management, advantages and disadvantages

The Programme is structured as a network where the management and co-ordination responsibilities are with AIT, and the NRIs from the participating countries co-operating in the research. This is a structure, which the AIT has been and is using for several other projects and which has proved efficient and constructive. In such a structure, however, there is a need to keep a robust balance between the AIT and the NRIs.

The 1998 evaluation remarked that the NRIs in the initial phase had very little influence on the Programme structure, the selection of the themes and on their evolution. This was obviously true during the initial phase and also in the transfer from the Phase I to Phase II, when almost all the NRIs were substituted. Between the Phase II and Phase III most of the NRIs were kept, thus being able to influence the projects to a higher degree. This more decentralized approach is also reflected when arranging workshops, which are held in different participating countries for the different projects. It is important to maintain a central manager for this kind of a network, for organizational reasons, but it is equally important, to include other participating institutes as equal partners.

5. Programme components for strengthening research capacity

There are two main types of programme components that would contribute towards capacity strengthening, the research projects and their effects on participating NRIs, and the Fellowship Programme. This kind of networking, particularly when the NRIs have been actively cooperating for a longer period, ultimately results in exchange of experience and thus in capacity enhancement, also within the NRIs.

The 1998 evaluation remarked that the capacity building component of the Programme was weak as the Fellowship Programme lacked linkages to the research themes through the participation of the NRIs. An attempt to make this linkage exists by the NRIs nominating the fellows, who are selected by the Principle Investigators of the themes. The Fellowship Programme varies between the different themes from including a short training period to performing research tasks, all at AIT. Even though fellows from the different countries may spend time together at AIT on training there is no real exchange between NRIs allowing for fellows to spend periods at another NRI.

There is very little building of capacity to address policy issues linked to GHG mitigation except for at discussions during programme or project review workshops. As this really is the weakest part of the Programme, there certainly is a need for enhancement of such capacity. It should involve not only policy scientists but also policy-makers at an early stage of the project as such stakeholders could partly contribute to building such capacity, and are needed for the Programme results to have the desired impact. Policy-makers have to some extent been involved, mainly in the small- and medium-size industryproject and undoubtedly some in the NRIs will have had policy influences at the national level that were not specifically reported upon in the documents evaluated. However, it is judged that there needs to be a more systematic approach for a possible next phase of the Programme.

6. Programme outputs, their quantity and quality and their applicability to impact GHG mitigation policies in the region

The research projects have been documented in all the different Phases by the production of a variety of outputs, voluminous in quantity, but mostly of a high professional standard. The documentation, however, sometimes reports too much on what has been done and too little on findings and results. The analytical parts are very seldom driven into any synoptic evaluation that would have served policy

aspects better. The scientific standard of the documentation varies between the more technical research work and the much weaker policy- oriented research. Even though some of the documentation is targeting policy-makers, such as the Newsletters, specifically those relating to the small- and medium-scale industries, and booklets, disseminating results of the Programme among policy personnel with a view to creating an impact on policy making is not enough to achieve any tangible policy changes. Unless the dissemination strategy more imaginatively addresses and involves policy-makers, the impacts on GHG mitigation policies for the region will not meet expectations.

7. Cost-effectiveness of the Programme

The Programme budget as applied for the Phase III (11 million SEK for 2001 and 2002) allocates ca 2/3 of the funding for activities by and related to NRIs, including 10 per cent of the funding for the Fellowship Programme. Actual NRI research project cost was allocated ca 40 per cent of the total cost. The 1998 evaluation sees the budget as reflecting the division of responsibilities and on those grounds the NRIs now have been allocated a larger parts of the responsibility than during the Phase I when their share of the budget was only about 15 per cent. The Phase III budget also includes a budget item for dissemination.

As no detailed cost figures for other relevant programmes could be obtained it has not been possible to make any analysis of cost-effectiveness compared with other programmes.

8. Conclusions and recommendations

The overall conclusions of the evaluation are therefore that:

- The Programme themes of Phase II and subsequently in Phase III are highly relevant in the perspective of energy-environment-climate as well as for GHG mitigation from a UNFCCC perspective for the region and its continued evolution.
- The objectives for the Phase III of the Programme were formulated for the Programme to meet the needs within the region and have not yet been achieved. A weak part is the targeting and co-operating with policy- and decision-makers. The technical options, strategies for GHG mitigation and policies so far formulated as a result of the Programme are reasonable for the region.
- The Programme has produced an impressive amount of results of a generally high standard. However, much of the extensive technical reporting would have benefited from a more condensed format, including less background documentation and more on findings and their synthesis. Scientifically, the weak part is the policy-oriented research where also an interaction with other programmes in the region and with policy-makers is lacking.
- The capacity building part of the Programme, mainly within the Fellowship Programme short training courses (1 month) or short research exercises (1–3 months) has not been reported on. It has not, therefore, been possible to report on results or their quality. The involvement of NRIs in the programme in the longer time-perspective under Phase II and III is increasing their research capacity.
- From a general perspective the trend in funding of the Programme is seen appropriate in comparison between the Phases I and III, in particularly concerning funds allocated for the research within the NRIs and thus their possibilities for capacity enhancement.

The recommendations from the team can be divided in two. For a fruitful finalization of Phase III there are the following recommendations:

- To ensuse clear linkages to other relevant programmes in the region for mutual benefit, through appropriate meetings, workshops or other means. This will ensure a clear regional focus on the outcomes of the Programme.
- Reporting on the Fellowship Programme, that includes training courses and research activities, should be given priority so that the participating Fellows and their respective NRIs have inputs into the process.
- To involve more systematic peer review of all major publications, including policy- oriented research publications, to ensure a format and presentation in these publications that optimize their impact and usefulness.
- To ensure a publication strategy that can be used for all the different themes. Such a strategy may include a database for background data (to decrease the need to include this information in all publications, thus decreasing the quantitative publication load) and different kinds of publications for different target groups, which may include (electronic) Newsletters for a broader audience.
- To ensure clear links between the technical research and the policy-oriented research, including the barrier analysis, and to involve policy-makers more directly in the Programme.
- To involve policy- and decision-makers to a higher degree in discussion and implementation of the dissemination strategy in order for the Programme to achieve the desired policy impact.

A possible Phase IV of the Programme should provide useful inputs to the countries' efforts under the UNFCCC in the area of climate change mitigation. To achieve this the evaluators recommend to the ARRPEEC team that:

- The research focus should be narrowed and concentrate on research that emphasizes means of GHG mitigation. Just as the PAH work was subsumed into another project in moving from Phase I to Phase II, in moving from Phase III to IV, the philosophy should be that if successful action is taken to reduce GHG emissions, benefits in terms of lowering emissions of other, local pollutants will accrue.
- Part of the focus on GHG should be on capacity enhancement for building the capacity for the eventual identification and prioritization of specific CDM projects, not just in the power sector but across the board of the whole programme, where this is appropriate. **This is a recommendation to now think strategically and make choices from within the four projects as a whole in order to prioritize elements**. The aim would be to enhance capacity to a level where it would be possible to specify individual CDM projects in detail to the point where they could be presented, eventually, in a form for permits to be assigned, once other formalities had been completed. Agents from potential investing countries need to be identified. The consideration of this is already well-advanced in *Annex II, Volume IV of the Phase II Draft Final Report.*
- To involve AIT, the NRIs and policy- and decision-makers from the participating countries in the prioritization Phase.
- At the initialization of Phase IV establish clear links with other relevant programmes in the region, including regional programmes of the UNFCCC and relevant programmes under the UNESCAP for exchange of experience during the full programme phase to mutual benefit.

– To carry out an analysis of the research results and likely outcomes so far in the light of certain 'SRES' scenarios (A1F1, A1T, A1B).

– To integrate the training- and research programme with the themes under the new Phase and to ensure that the results linked to the Programme will be reported in such a way as to increase the capacity not only of those participating in the Programme but also other relevant groups at the NRIs.

– To establish a general publication strategy that should be used for all the themes under this phase under which appropriate outputs are defined for the different target groups. Peer reviewing, as appropriate, should ensure the continued high scientific standards of the outputs and optimize their relevance to a range of target groups.

– Consideration should be given to setting up Steering Committees for each of the four projects that would include representatives of the researchers, policy-makers from government and representatives of commercial interests. The Committees should review the research carried out so far and agree priority areas for further work.

– Consideration be given to how a series of round table meetings, or policy dialogues, could be instituted. Decisions would have to be taken on whether these round table meetings should be established on a country level or regional level and whether they should consider all four research themes together, or separately. It would be advisable to recruit expertise both from within the Region and from outside.

– An alternative to policy dialogues and a round table approach would be to commission a synoptic report on the major significant research findings from the Principal Investigators for the four projects. This report would concentrate more on integrated findings and less on specific results for the four project areas and would serve as a "position paper" submitted to a specially constituted **Advisory Committee.**

– The **Advisory Committee**, that should be small and interdisciplinary and comprise specialists such as policy analysts and decision-makers, energy economists and the principal investigators, should be operative both during the initiation and the continued work of the new programme phase and play a key role during review workshops ("performance audits"). Initially, the Advisory Committee should be charged with preparing a draft programme proposal for Phase IV. This proposal would utilize the "position paper" prepared by the Principal Investigators as a starting point to formulate an enhanced policy-oriented and economically feasible Phase IV. Examples of elements that might be a starting point for the Advisory Committee are given below.

– A regional workshop would subsequently be organized to consider the new programme proposal for Phase IV. This workshop would include participation from Sida, representatives of other energy, environment and climate change programmes in the region (including at the UNESCAP), and stakeholders (including government officials, industry and power representatives, NGOs, and other researchers). The purpose of this workshop would be to assess the proposals for Phase IV, suggest other inputs and finally give a form of 'legitimization' for the new phase. The intention would be to broaden Phase IV of the Programme by ensuring a significant contribution by relevant policy- and decision-makers and to include economic considerations of energy systems. A broader scope of the Programme Phase IV would also contribute to enhanced capacity in the region to address issues of importance for those countries within the framework of the UNFCCC and the Kyoto Protocol.

– As the ARRPEEC programme has proven its value in the energy-environment-climate arena, where it is unique in Asia; this is an area that is of importance for climate mitigation within the

framework for undertakings under the UNFCCC and it is now essential that in the discussions leading to the next phase of the Programme there should be capitalization on the technical research results. These results have demonstrated how increased energy efficiency and reduction of fossil fuels in the energy sector in Asia, both for industry, power and urban households, and the transport sector, might enable GHG mitigation to be achieved in a practical manner. The next phase of the Programme should adopt a more integrated and strategic prioritization to the selection of topics for continued research support, based on a mix of measures that are targeted to attain optimum mitigation. Consideration might be given to elements such as the Industry project, which concentrated on five small and medium-sized industries that showed promising potential; and the Power-sector that investigated relatively smaller power systems and was able to identify projects that might develop into CDM projects. These should serve as a starting point for a more integrated approach during the next phase. The urban transport project might identify more significant GHG mitigation by concentrating on some of the rapidly growing secondary cities or suburban areas where it is likely that significant results are achievable. The Biomasss work might make a contribution by concentrating on specific, medium-sized projects where progress might be easier to achieve. Such considerations by an Advisory Committee would enable Phase IV to continue the Programme evolution to a co-ordinated, regionally focused research effort that is able to have maximum policy impact.

1. Background, Programme Evolution and Structure

The reasons for initiating the Programme, the manner in which it was set up and consequently developed, the scheme of management and the special elements associated with the Programme, as well the substantive topics of research will be described in the course of this evaluation report. The report will necessarily make observations and criticisms of some aspects of the Programme. However, this should not detract from the professionalism and very high quality of much of the research, reporting and training that the Programme represents. The evaluation assessed the Programme results against the stated objectives of the research. This assessment relied almost entirely on the documentation that was provided by the research team.

1.1 Background to the Programme

There is now a large measure of agreement that the Earth's climate is changing and these changes are mainly the result of human activities that have caused increases in the atmospheric concentrations of greenhouse gases (GHGs) and aerosols. The 1990s appear to have been warmest decade, and 1998 the warmest year, in the instrumental record since 1861 (IPCC, 2001). The most important cause of the increase in GHGs is the combustion of fossil fuels, mainly for energy production for the power sector, the industry sector and households, but also to supply power to the transport sector.

Conventional energy consumption of the developing countries in the Asia Pacific Region has substantially outstripped the growth in World energy use and the heavy dependence on fossil fuels in the economies of South, East and South-Eastern Asia also results in environmental degradation resulting from air and water pollution. At present developing countries have no obligation under international agreements to greenhouse gas emission reduction but, in view of the rapidly growing energy demand such countries exhibit in Asia, it is likely that they will have to become more involved in future as part of global efforts to stem the rate of increase in emissions.

1.2 Programme Evolution

Against this background the Asian Institute of Technology (AIT) initiated the Asian Regional Research Programme in Energy, Environment and Climate (ARRPEEC) in 1993. ARRPEEC was conceived as a network of National Research Institutes (NRIs) in selected countries with AIT as coordinator and administrator. AIT would also provide research leadership, conduct research training and be actively involved in performing part of the research work. The Programme therefore had a strong commitment to regional co-operation and encouraging links between NRIs and hence harmonizing the focus of country policies. Financial support for the first three years (1995–1998), ARRPEEC Phase I, was approved by Sida in 1994 at 9 million SEK.

The Sida rationale for support was that ARRPEEC, through a network-based research programme on strategies and environmentally sound options, would address the increasing dependence on fossil fuels and the local and global environmental consequences. Continued support has been provided as the Programme has the potential to supply government policy-makers with realistic and applicable options for GHG mitigation and could also dramatically improve the local physical environment, particularly by a reduction of urban air pollution.

The ARRPEEC rationale for the Programme at its initiation was to:

- enhance understanding of Energy-Environment-Climate (EEC) issues and improve the expertise of researchers in the Asian region;
- provide opportunities for institutions in the region to work together as EEC problems could not be solved by countries in isolation;
- give younger researchers the possibility to focus their research on key EEC issues in the region;
- grant finance for equipment that would enhance facilities at AIT, providing opportunities for fellows to improve their research work.

A key element of this centrally co-ordinated, regional effort was to build policy-oriented research capacity. Phase I of ARRPEEC was evaluated in 1998 and this evaluation is reported on in Christensen and Mackenzie (1998). It included the view that policy impacts had received insufficient attention in Phase I and immediate attention was needed to strengthen this side of the work.

Phase II of the Programme started in January, 1999 and was seen as a logical continuation of Phase I. In the light of the recommendations of the evaluation of Phase I, ARRPEEC Phase II was to focus on quality research, capacity mobilisation and enhancement, and policy impact. Greenhouse Gas (GHG) mitigation was the central theme running through all of the Phase II projects. This required the identification and assessment of national GHG mitigation options. There was concern also about local water and air pollution issues. Thus, the need to establish linkages at the project level in participating countries with national, regional and global initiatives for reducing emissions was seen as important. Phase II continued until the end of 2001 at a level of support of 19.5 million for 1999–2001.

Phase III of ARRPEEC, which begun in 2002 was granted 11 million for 2002 and 2003. It is still current, involves four regional projects in the same areas of research as Phase II. It also involves twenty-five National Research Institutes (NRIs) from eight Asian countries although there were some small changes in which institutes were the collaborating ones. Again, Phase III is seen as a logical continuation of the previous phase. It is recognized that that there is a great deal of commonality among the eight participating countries in terms of the methodology, approach, technical options and barriers to progress as far as the mitigation of GHG emissions is concerned. Thus Phase III provides further opportunities for the NRIs to work together in partnership with the Asian Institute of Technology (AIT), develop research methodologies and to gain professionally through the sharing of experience and exchange of results.

It is Phase II, and the work on Phase III so far, that is being evaluated in this report. This includes four projects:

- small- and medium-scale industries in Asia: energy, environment and climate interrelations;
- mitigating environmental emissions from the power sector: analysis of technical and policy options in selected Asian countries;
- analysis of technical options for mitigating environmental emissions from the urban transport systems in selected Asian countries; and
- biomass energy in Asia: a study on selected technologies and policy options.

1.3 Programme Management

Programme management has from the beginning been located with the Energy Programme of the School of Environment, Resources and Development at the Asian Institute of Technology (AIT) in Bangkok, Thailand. The Programme activities have been organized in research projects with a somewhat different composition during the different phases of the Programme (see below). A varying number of National Research Institutions, NRIs, from countries in the region have been involved in different parts of the Programme. The NRIs have not been co-ordinated at the respective country bases but by AIT, based on the project in which they have been involved.

The 1998 evaluation of the work found the Programme was initially strongly skewed towards AIT control and concluded that the national institutions participating in the Programme had limited influence on the scope of the projects. On criteria for selection of NRIs, they found that the initial selection of NRIs seemed to have been based to a large extent on personal contacts and links with AIT alumni and that the choice of the selected group of NRIs seemed to have been guided by an ambition of obtaining a geographical spread and a mix of research and policy institutions.

In selecting the NRIs to participate in the projects under Phase II the coordinator and the AIT team, based on the performance during Phase I, invited the best NRIs from Phase I to continue and to be joined by new partners. Comparing the composition of NRIs participating during the first and the second phase, however, it is obvious that the whole selection has been revisited as very few of the NRIs that participated during Phase I are actually participating during Phase II (according to the list it is only one!). There is also a team member from an NRI during the Phase I participating in Phase II but representing a different NRI. There has been a change in the NRIs coming from the countries participating in both Phases I and II but there has also been some changes in participating countries so that Nepal and Pakistan that were among the countries from where NRIs participating in Phase I came were, for Phase II, substituted by Malaysia and Indonesia.

Between Phases II and III the changes in the emphasis of the projects were due to progression of the research and therefore it might be expected that this would be reflected in the composition of NRIs participating. For the power sector project there are two new NRIs, and the NRI from Malaysia that participated in the biomass project during Phase II (the only one from Malaysia) is no longer included and has not been replaced. Two other changes in NRIs are due to experts having changed their institutions. They remain on the team but under a different NRI.

In the proposal for the Phase III it was emphasised that the third phase would provide increased opportunities to the NRIs to work together in a partnership with AIT, to "jointly develop research methodology, to gain professionally through sharing of experience and exchange of results and to identify and assess important national GHG mitigation options". This more participatory approach in the research work was also reflected during the review workshop in September 2003 (see Annex I).

1.4 The Role of Fellowships in the Programme

Part of the research strategy and the efforts to improve the understanding and expertise of researchers in the region was addressed though a Fellowship Programme. The administration and co-ordination of the Fellowship Programme has been undertaken by AIT. Candidates have been nominated by a collaborating NRI (or by a national agency) but the selection made by the Principal Investigators of the Programme in consultation with Sida. The research fellows (57 in Phase II) carried out their research at AIT.

For the Biomass project, research fellows from the participating countries spent two months together at AIT at the beginning of Phase II in 1999. A partly different group of fellows spent a month together in the beginning of 2001 and again a partly different group spent a month together at the end of 2001. One of the fellows was included in all three visits, a few of them in two visits but the majority were just included in one. Thus, most of the fellows spent only one month with the programme. The different research topics are not specified for the fellows following the Biomass programme. It can, however, be assumed that these fellows had an opportunity for useful discussions with fellows from the other NRIs and with AIT scientists. However, the time permitted to each fellow normally would not allow for much individual research work.

The Power Sector project and the Urban Sector project used another approach. Their fellows spent two, three or four months on the Programme on clearly identified research topics. For some of the NRIs a research fellow could return for a second period, dealing with a different research topic under the same project. Research fellows from different NRIs have normally not spent their period together at the AIT. It can thus be assumed that they could be supervised individually in their defined research topics, having extensive research interaction with the AIT scientists but presumably less with fellows from other NRIs.

The SMI project had some of their research fellows participating in training for one month during the summer of 1999 but the majority of their fellows were working on research topics later on in the Programme. This means that the first fellows were trained in a group of individuals from the different NRIs but that the second group did their research work individually, supervised by the research team for the SMI at AIT. For Phase III the fellows that stayed at AIT for a month to be trained also trained other people in areas mainly linked to barrier analysis in SMIs in their respective countries.

The documentation only reports on how much time individuals have spent as research fellows. It is, however, very difficult to find out to what extent these periods spent at AIT have contributed to the outcomes of the different projects or to what extent it has served in capacity enhancement for the participating NRIs or the fellows themselves. There is no reporting from fellows on their experience as a fellow. Some of the fellows participating in the programme do so as post-doctoral fellows, two of them even as professors, but the majority are at a less advanced level. It would have been very valuable to have first-hand assessments from fellows in order to evaluate the results of this part of the Programme, as it accounts for about one-quarter of the cost of the research programme and constitutes the most important capacity building component.

1.5 Research Themes

The research themes, designated as 'projects', under the Phase I addressed issues having an emphasis on transboundary emissions and energy efficiency. They included:

- a study of biomass as an energy source and technical options for its use for greenhouse gas (GHG) emission reduction;
- assessment of energy-efficient options for mitigating greenhouse gas (GHG) emission from electricity sector;
- development of energy-efficient and environmentally sound industrial technologies in Asia; and
- the emission of polycyclic aromatic hydrocarbons (PAHs) from energy-related sources.

As was recognised in the 1998 evaluation of the Programme, the first three themes are broad sector- or fuel-oriented themes and include important local as well as global environmental aspects, where an

achieved energy-efficiency is of importance, particularly at local or national level while GHG mitigation have global benefits. The evaluators saw that as important as it is unlikely that the participating countries will make major decisions based only on climate change concerns in the foreseeable future although they would like towards encouraging this. The 1998 evaluation also saw the theme dealing with PAHs as much more narrowly oriented towards pollution and pollution monitoring even though it is energy-related and thus linked to the others. Thus this theme was subsumed into the biomass project and not developed independently in the other phases of the research.

Of the four themes of Phase II, three were developed out of themes of Phase I, while a new theme of great importance in terms of mitigation of GHG emissions was initiated on the urban transport sector. The themes were the following:

- small- and medium-scale industries in Asia: energy, environment and climate interrelations;
- mitigating environmental emissions from the power sector: analysis of technical and policy options in selected Asian countries;
- analysis of technical options for mitigating environmental emissions from the urban transport systems in selected Asian countries; and
- biomass energy in Asia: a study on selected technologies and policy options.

In the objectives for this phase the need to produce policy-oriented research results, both for the mitigation of GHG and other hazardous emissions and for the promotion of energy-efficient solutions was emphasised. These objectives are also reflected in other issues to be addressed, although they were not always clearly reflected in the final outcome. This might be because a project such as one addressing the problems in several different types of industries (SMIs), is concentrating on technical aspects of energy efficiency and environmental soundness in each industry and to a lesser degree on any common policy. The power sector project at this stage is clearly addressing issues of emissions mitigation where policy aspects need to be included. The urban transport project is trying to address barriers to energy efficiency improvement of urban transport, which needs to include policy implications although the project, being in its first phase, is also concentrating on demand assessment and assessments of energy efficiency improvements for the sector. The biomass energy project is addressing policy options for promoting promising renewable energy technologies. Thus all the themes are, addressing policy-related issues. These concern mainly energy efficiency or renewable energy technologies, both measures that would result in decreased emissions of GHG.

In Phase III all four themes were further developed:

- The project on small- and medium-scale industries in Asia continued work on technical aspects of estimating GHG emissions, addressed policy options for and barriers to introducing more energy efficient and environmentally sound technologies.
- The power sector theme, now defined as "Strategies for promotion of energy efficient and cleaner technologies in the power sector" also concentrated on mitigating emissions by identifying different options, including least-cost supply-side options. The project addressed issues such as identification of barriers to the adoption of the selected technologies identified as options during the previous phase. Further it addressed measures to overcome these barriers including economic instruments such as taxes and incentives.
- The urban transport theme is in Phase III (the second stage of this theme) identified as "Strategies for promotion of energy efficient and cleaner technologies in the urban transport system".

During Phase II the project addressed issues of identifying energy efficient improvements as well as transport options that might contribute towards mitigation of GHGs and other environmentally harmful emissions. Barriers to implementing the options were identified. For Phase III the project concentrated on identifying measures to overcome barriers and on measuring air quality impacts of the selected options.

– The biomass project, in Phase II, defined as "Biomass energy in Asia: assessment and strategy formulation" assessed the most promising biomass technologies, identifying government policy options for promoting promising renewable energy technologies and identifying other means for reducing pollutant emissions from more traditional energy systems. Phase III continued with the characterization of promising Bio-Energy Technologies (BETs) and the identification of strategies to remove implementation barriers.

Phase III is seen as a logical continuation of Phase II and during this stage in its work the Programme continued some of the more technical aspects of estimating GHG emissions but also addressed policy options as well as barriers to introducing more energy efficient and environmentally sound technologies.

2. Research Progress and Achievements

Having reviewed the evolution of the research programme and projects from Phase I to Phase III and the shift to a focus on the overarching theme of GHG mitigation measures and policies, this section evaluates the actual progress along this trajectory and specific achievements of the four research projects.

2.1 Progress towards increased capacity for GHG mitigation

The development and evolution of the themes from Phase II to Phase III seem, at least as identified in the issues to be addressed, to be very logical and necessary. There is a sequence from more technical aspects, such as identifying technologies for promotion of energy-efficient techniques, providing less environmentally harmful emissions containing decreasing amount of GHGs, to more-policy oriented and political aspects. This includes identifying barriers for the adoption of the identified techniques. However, sometimes this identification seems to be more an identification of the traditional groups of barriers and less the ones that will be experienced when the outcomes of the ARRPEEC are to be implemented at governmental level. The reason for that might be that the methodology used, the Analytical Hierarchy Process (AHP) method obviously has its limitations. If the results from the different countries have to be comparable, the parameters have to be chosen from that perspective and not based on the different circumstances in the different countries.

From the perspective of the region the four themes as established in Phase II and further developed during Phase III are highly relevant to the over-arching theme of GHG mitigation. The countries are situated in a region with a high rate of population growth and a high rate of urbanization as well as rapidly growing industrialization, particularly at the level of small and medium-sized industries. The energy need and consumption in the region is thus rapidly increasing, a need that to a large extent is met by combustion of fossil fuels, in the power sector but also in the urban transport sector, thus resulting in important emissions of GHGs as well as other emissions harmful to air, water and soil quality as well as detrimental to human and to ecosystem health.

From that perspective the introduction of renewable energy that is the focus of the *biomass project* is highly relevant. (Specific aspects of the different projects are discussed later). As developed from Phase I to III, the Programme could have represented an important contribution in taking the methodology forward by identifying and ranking the barriers to the deployment of the selected BETs and developing strategies to remove these barriers. It seems however, that the methodology used, the Analytical Hierarchy Process, was difficult to apply and, thus, strategies to remove barriers have not yet been adequately discussed. These problems were more obvious for some countries than for others. The reason for this is that strong links to policy- and decision-makers were often missing. Although the project has relevance to the countries selected, it may thus not have the full impact it aims for.

As in the region *small- and medium-sized industries* account for a very large proportion of the industries and industrial expansion (for example China 99 per cent of all enterprises and 60 per cent of industrial sales and for Vietnam ca 28 per cent of the national industrial output), it seems highly relevant, in view of this increasing energy demand, for the project to address the promotion of energy efficient and environmentally sound technologies and strategies in this sector. Investigation of technical aspects related to emissions from different types of industries can be found elsewhere, as can, to some extent, policy aspects but what is lacking is the application of this approach to the Asian region. The Phase II SMI-project addressed methods of pollution prevention and mitigation of GHG emissions by considering, among other factors, energy consumption, process efficiency and raw material usage, which for the participating countries were of high priority. The project, during its third phase, is addressing the barriers, and the strategies to overcome those barriers, by using the AHP-methodology. This project design, in trying to take an integrated approach to the SMI-perspective, has a high degree of relevance. However, this project as well as the Biomass project, has difficulties obtaining good results in the barrier analysis, mainly due to lack of involvement of policy- and decision- makers.

Both the Biomass- and the SMI-project are developed out of the structure during Phase I of the Programme. The *Urban transport project* was introduced during Phase II to meet the demand for measures to address rapidly increasing emissions including GHG-emissions from the transport sector. The selected mega-cities are rapidly growing and thus increasingly contributing to GHG-emissions and other harmful emissions in the region. The project under Phase II, by using different scenarios to suggest options for the mitigation of the emissions, and subsequently under the Phase III by addressing the barriers to their application, is taking an integrated approach to the problem that is very relevant. Again, the problem might be that as policy- and decision-makers are not sufficiently involved and the application of the results may not always recommend themselves in these quarters.

The *power sector project* seeks energy efficient options for mitigating emissions of GHG from the electricity sector, thus addressing a broad issue for society, a sector that is increasingly contributing to the GHG-emissions. The project is applying both technical and management options in a scenario structure in Phase II. For some of the countries they are applied to specific regions. The options are, during Phase II, the bases for which the project, by involving utility planners, utility investors and policy makers are identifying and ranking barriers to the adoption of cleaner technologies (CTs) and energy efficient technologies (EETs). Measures to overcome those barriers are also a focus of attention.
The project further investigated implications of carbon and energy taxes as instruments for the application of the CTs and EETs that should result in reduction of GHGs. This project now has a very high degree of relevance on a broad front. It investigated different options that are of relevance to the sector, to the region and could have a significant impact on GHG-emission reduction. More than any other project, by involving a wide spectrum of stakeholders, such as utility planners and investors and policy-makers in identifying barriers, it has laid the bases for identifying successful measures to overcome these barriers. The project also resulted in identification of possible CDM-projects, another means for encouraging the reduction of GHGs.

In the process of development from the Phase II to the Phase III, all four projects are trying to address the issue of barriers to the effective implementation of techniques for energy efficiency, the application of cleaner technologies and the reduction of GHGs. This development of the programme would, if conscientiously applied, involve all the important stakeholders including policy- and decision-makers, resulting in important achievements for the countries in addressing issues and contributions to the objectives of the UNFCCC and the Kyoto Protocol. So far, unfortunately, most of the projects in most of the countries do not sufficiently involve policy- and decision-makers. Thus, even if the project objectives are relevant, the impact of the projects may not always be as effective as desired.

2.2 Progress in the individual research projects

Aspects of the four research project results are evaluated here against a background of their stated objectives

2.2.1 Biomass energy in Asia

The Biomass Project spans Phases I, II and III of the Programme. It is an ambitious study that seeks to assess and characterize emerging energy technologies that could utilize biomass fuels to provide energy services and thereby reduce reliance on (mainly) fossil fuels, reduce the intensity of GHG emissions, and a range of atmospheric pollutants, and identify policy options, and barriers to these, for promoting the technologies. Six countries participated, only five submitting reports. Of the seven biomass energy technologies that emerged, one was improved cooking stoves in India, Philippines, Sri Lanka and Thailand.

Policies for the deployment of the technologies were identified and specified and an Analytical Hierarchy Process (AHP) was developed for ranking barriers to deployment. All five country studies were thorough and logically pursued. The research and the quality of the results were at a level of sophistication that is to be expected in the Programme. The AHP takes the approach beyond the mere listing of barriers to implementation and the description of solutions in a few short phrases. It was therefore disappointing not to find a more prominent synoptic account of the way in which the AHP had illuminated (or failed to) the whole issue of policy making. Two fellowship reports grappled with the problem of technology transfer mechanisms, illustrating that the key to this lies not only in recognizing key elements in the process but linking them into pathways to which key constraints may be recognized – a form of critical path analysis.

To the general approval of the research and reporting of this impressive Biomass Project may be added two comments for consideration. Firstly, in spite of the undoubted importance represented by local emissions of NO_x, SO_2, CH_4, TSPs and VOCs to specific sectors of the population, the research on cooking stoves now sits unconformably with the rest of the Biomass Project. Indeed, this is tacitly recognized in the reporting as the work is specifically excluded from the summary booklet, *Energy, Environment and Climate Change Issues: a Comparative Study in Asia.* Cooking stoves have received considerable research attention for several decades. Some of these studies were extremely thorough and the technological findings were fully integrated with social and financial factors[1,2,3]. These studies cautioned against expectations of fuel savings and benefits for users as test results were seldom achieved under normal operation. They concluded that establishing a long-term effect of introducing improved stoves is a complex procedure and requires a thorough, detailed analysis of local conditions. It is something of a surprise that neither these conclusions nor the publications they are contained in find any mention in

[1] Raju, S.P. (1953). Smokeless Kitchens for the Millions.
[2] Foley, G. & Moss, P. (1983). Improved Cooking Stoves in Developing Countries. Earthscan, London.
[3] Foley, G., Moss, P. & Timberlake, L. (1984). Stoves and Trees. Earthscan, London.4 IPCC (2000). Special Report on Emissions Scenarios. Cambridge University Press, Cambridge

the work reviewed here. In spite of undoubted advances with cooking stoves, the caution expressed in these earlier studies still seems well-founded.

Secondly, it is a little surprising in the assessment of the environmental impact of using biomass for energy generation to find how little consideration has been given to factors other than atmospheric emissions. Of course, a reduction of GHG emissions will be the main focus of this work but considerations of conflicts of land-use, outcomes for maintenance of biodiversity, water availability and use, land occupation and the consequence of inputs of resources, such as fertilizer, warrant comment as aspects for others to weigh in any consideration of both costs and benefits.

For a continuation of the work it is suggested that the emphasis now switches to the socio-economic factors that impinge on the whole range of stakeholders' interests affected by a change to biomass technologies and would be crucial in the determination and progress of policy initiatives along the pathway to implementation on a significant scale.

2.2.2 Mitigating environmental emissions from the power sector

The Power Sector Project is a particularly important and germane component of the ARRPEEC Programme. The Project addresses least-cost supply-side options for mitigating GHG emissions, which projects might have sufficient GHG mitigating potential to form promising CDM projects and, thirdly, the environmental implications of increased contributions to energy supply by independent power producers (IPP) and moves in the direction of distributed power generation (DPG). The research carried out in six countries, considers emissions of CO_2, SO_2 and NO_x and costs of different emission reduction targets, including total costs and marginal abatement costs. It focuses down to type and even location of the plants. It concludes that improvements in emission levels would shift generation away from coal to combined cycle gas-based power, and to hydropower. The level of detail provided engenders some optimism that it would be possible to move from identification to implementation of an energy use mix that lowers considerably CO_2 emissions and the emission of other atmospheric pollutants.

The research is firmly based in the country studies but convincingly integrates these on a comparative basis. It demonstrates one of the strengths of the NRI – AIT organizational arrangements. It would now complete the circle of problem identification, research planning and activity, research integration, research results, comparative analysis, research synthesis, policy formulation, policy instrument identification, implementation and monitoring if some policy-making input were available. The reporting already points to the reform of regulations applicable to the power sector in selected countries. Policy-makers need to be involved in any future planning and progress of the work.

The whole project has about it the characteristic of professional competence. Nevertheless one or two features raise questions. One relates to the marginal abatement cost (MAC) estimates. It defies belief that the marginal abatement cost of moving from 10 to 15 per cent CO_2 emission reduction costs less, per tonne of carbon, than a move from 5 to 10 per cent reduction in Indonesia, NREB-India, Thailand and Vietnam. *The Regional Comparative Analysis Report* of this project comments that, "contrary to economic theory", the marginal abatement costs do not increase with increased targeted reduction of CO_2 emissions in some countries. Some consistent MAC curve construction, that identified the points of appropriate emission reduction interventions, might have shed some light on these inconsistencies

Although in the least cost supply option, increases in IPP, DPG and identification of CDM projects work, the change in environmental emissions (CO_2, SO_2 and NO_x) are fully dealt with, other environmental impacts are all but ignored. Will the range of changes involved in technology substitution and IPP and DPG activities be environmentally and socially beneficial at the local level? Will one set of problems be substituted by others? Such considerations should be factored into future work.

The reports refer to increases in electricity generation total costs associated with specific emission reduction targets, specific CDM projects, and IPP and DPG activities. It is not clear whether this implies an equivalent unit cost increase to the consumer whose unit cost usually includes costs of transmission, management and even research. These three operations may not show equivalent cost increases (and might even decrease with IPP or DPG). Thus costs to the consumer may be proportionately lower.

2.2.3 Mitigating environmental emissions from the urban transport system

Phase II has analysed the technical options for GHG mitigations from the urban transport sector. Eight rapidly growing megacities in five participating counties where urbanisation is increasing are the subject of the research. The demand for transport services is expected to continue growing at a high rate and the initial study analysed the growing demand and associated energy demand and emission of GHG as well as other environmentally harmful emissions. Options for improved energy efficiency and reduced emissions were identified and barriers to the introduction of selected options were identified and ranked. During the third phase of the Programme the Project is developing research on measures to overcome these barriers and on air quality impacts of the selected technological options.

In the work on analysing urban transport demand and associated energy demand and environmental emissions of different types, scenarios are being used, both to determine the fuel share when utilising different transportation mixes in the cities and to determine the total energy demand based on certain fuel shares for the year 2005 and 2020. Estimations of emissions of local pollutants (such as CO, SO_x, TSP, NO_x and HC) as well of CO_2 are carried out locally and the methodology used is the dispersion model MUAIR. Emission mitigation potentials for different vehicle combinations and analysis of a least-cost vehicular mix were based on an analysis of the cost effectiveness of selected options. Analyses of energy demand and emission levels were carried out by using the LEAP-model (Long-range Energy Alternative Planning) for different economic growth scenarios. The identification of barriers for the different cases was attempted. The results of that identification were not always compatible. For the ranking of barriers the AHP-model was used for those identified but locally different barriers had to be considered. The eight fellows that followed the research were involved in different parts of the programme, on emission analysis, on cost scenario analysis as well as on application of multi-criteria decision-making tools. Possibly this approach might have been applied in the research on barriers.

During Phase III, the second stage of the urban transport project is determining the degree of air pollution in the megacities of the study. For this the project needs to rely on existing monitoring systems, which is the reason that the degree of accuracy of any base line situation for the different cases is very different and not always compatible. When applying the MUAIR model the results are very different. When a cross-country analysis is done there will thus be a need for a probability analysis of the material that is to show the variations in baseline data and thereby in the analyzed results for the different countries in order to provide a reference point against which to judge any potential mitigation action (such as optional transport mixes) undertaken.

In the presented material there is some confusion concerning the scenarios used, including definitions of the scenarios when applying the LEAP-model (See *ARRPEEC, Phase II Draft Final Report, Annex III, Volume IV*). If the national results are to be used for a cross-country analysis it will be necessary that the variables used and the type of scenarios used are the same. As presented by the documentation and at the Annual Review Workshop (Annex I) they are not fully compatible. This project is now in its second stage but still most of the NRIs are trying to identify different options as was reported at the Annual Review Workshop (see Annex I). Thus, it is important to use the same time horizon for the economic growth scenarios. This will facilitate the analysis from which compatible policy options are to be synthesized. The barriers presented in this Draft Final Report seem to be concluding results of an applica-

tion of the options as presented. The methodology that was followed to identify these barriers is not clear. This might be one of the reasons why they do not appear to be fully compatible.

Even though the project has not yet reached a level where a cross-country analysis can be done there are some very interesting results emerging. Vietnam, having access to a large amount of baseline data has been able to, based on the LEAP-modelling, suggest policy measures, factors and actors according to a system that seems very promising. China is applying the model with the aim of presenting concrete policy options and measures to overcome barriers towards the introduction of an energy efficient urban transport system with the application of cleaner technologies that can be instituted for the Beijing Olympic Games 2008.

According to the terms of reference for this evaluation, consideration should be given to other regional programmes in Asia. The APMA programme (Air Pollution in the Megacities of Asia), that is part of RAPIDC (Regional Air Pollution in Developing Countries) and CAI-Asia (Clean Air Initiative for Asian Cities) are Sida supported programmes that aim at providing a regional approach to improving urban air quality through institutional development, and capacity enhancement (see Section 4). It is extremely surprising that these two programmes receive no mention in the research reviewed here.

2.2.4 Small- and medium-scale industries in Asia

Already during the initial Phase of ARRPEEC, energy intensive, highly polluting industries were regarded as important to address in the rapidly industrialising countries that are the subjects of the Programme. During Phases II and III the Industry Sector Project has concentrated on five industrial sub-sectors in five different countries. Data on their energy use and polluting emissions were obtained and alternate energy-efficient and environmentally sound technologies identified. Their techno-economical viability was assessed. The project developed different scenarios for the sustainable promotion of energy efficient and environmentally sound technologies (E^3ST). For Phase III of this work technical research to improve energy efficiency and pollution mitigation of specific E^3ST was undertaken. Based on results from the scenarios and existing policy barriers to the promotion of E^3ST and measures to overcome these barriers were investigated. For the different sub-sectors not only GHG emissions were identified but also other types of polluting emissions, both air polluters including SO_2 and emissions of organic and inorganic wastewater and solid waste. The E^3ST options investigated included technical ones, such as improvement in raw materials and process technologies leading to electrical energy saving or use of renewable energy and waste heat recovery systems.

When estimating the GHG emissions from the selected SMIs an IPCC based methodology is used to make cross-country comparisons on GHG emissions and mitigation options possible. Such comparisons have so far shown that impacts resulting from energy use and pollution load are individually small for the SMIs but collectively high, that the selected SMIs in general show low energy efficiency, and that the energy and environment policies that can be applied are not specific to SMIs. The comparative scientific analysis demonstrates one of the strengths of the networking approach that is taken in the ARRPEEC Programme. The ongoing analysis of barriers to the promotion of E^3ST in SMIs, and measures to overcome such barriers, is a logical continuation of the research work. For any results of the research to be implemented it is, however, important to involve social and economic scientists and policy- and decision-makers to a higher degree.

This project can be seen as demonstrating a high degree of professionalism. This is clearly visible in the documentation. Among the clear advantages is the analysis of energy efficiency versus environmental pollution reduction and its implication in the different SMIs of the project. The methodologies used in this research were modified to be applicable to the different countries, which made a comparative analysis possible. It also laid the bases for discussion of barriers in promoting E^3ST and an identification of barriers that are more site specific than the ones identified in an AHP analysis.

An analysis of barriers based on the different parameters identified under this project would have been useful to pursue. An AHP-type of analysis of barriers, to give reliable and useful results, often requires more social, economic and management data than it might be possible to obtain from the countries participating in the ARRPEEC programme. The barrier analysis that has been initiated under Phase III not only requires the participation of policy-makers, but for the results to be able to used effectively in promoting E^3ST in the SMI-sector, social and economic scientists should be involved to a greater degree. This might ensure a better transition from research results to policy establishment and on to actions for GHG mitigation within the SMI sector.

The SMI project is also the one showing a more systematic involvement of policy-makers (mainly in Sri Lanka) as well as cooperation through interaction with other relevant scientific programmes, mainly in Sri Lanka and the Philippines.

3. Outputs and Reporting

The research projects or themes have been documented in all three Phases (I, II and III) by the production of a variety of outputs. All of these address the topic of energy, environment and climate in Asian developing countries in a cogent way. There is, however, less evidence that there has been a serious understanding of how to undertake the difficult task of building policy-oriented research capacity.

The outputs include the following.

– Reports specifically prepared to document the work of the Sida study as part of the contractual requirements. These are organized in relation to themes included in the study, specific reports relating to these themes from the individual National Research Institutes (NRIs) in the relevant countries, project overviews and summaries of the key findings, and regional comparative analyses.

– Accounts of specific topics have been, also, published in peer- reviewed international and national journals.

– Special editions of established journals, guest-edited by some of the senior investigators working in the Programme.

– Papers presented at conferences.

– Newsletters, specifically those relating to the Small and Medium Scale Industries (SMIs) project.

– Special publications of booklets relating to the ARRPEEC study for individual countries, and comparative studies for much of the work.

– Special publication of booklets on individual industries (tea and desiccated coconut) and policy interventions relating to these.

– A CD on five SMI sectors.

All in all, the effort and professional competence exhibited in the reporting outputs are impressive. Phase I of the Programme was evaluated in 1998 and there Christensen and Mackenzie (1998) commented upon the "voluminous" nature of the outputs. They also emphasized the need for summaries of the work and integrated overviews. They recommended that Phase II should have a significant increase in attempts to ensure policy impacts. The outputs for Phase II and part of Phase III, evaluated

here, are also voluminous, amounting to nearly 500,000 words, the equivalent of eight to ten substantial printed volumes!

It should be made clear that, in the main, the Reports, scientific publications and indeed the other outputs are mostly of a high professional standard. Nothing that follows should detract from this. It is obvious that a huge effort has been made to document the work undertaken, and the results, in a full and informative manner. However, as Christensen and Mackenzie emphasized over and over again the documentation should go beyond traditional, academic reporting procedures. As noted above, they argued for a significant increase in reporting, and a strategy for reporting, that would make an impact on policy makers. The overviews and summaries of key findings that form part of the present outputs are useful (although in places they comprise only sections lifted from the body of a more extensive report). But it would have been helpful if these summaries and overviews had concentrated less on what had been done and more on the findings and results, together with an assessment of their significance in the overall context of the study. To give but one example, in Phase III Second Progress Report, referring to the Biomass Energy in Asia project it is stated, "…the NRIs selected three most promising BETs in each country…" and "Based on the agreed methodology, detailed characterization and assessments of the selected BETs were carried out." Nowhere in this Summary Report are the technologies identified or the characterization features summarized. Synthesis should follow analysis and while the latter is one of the hallmarks of this work, the former is only sporadically attempted and a synoptic evaluation of the results does not always emerge.

In addition, there is still only scant evidence of attempts to **engage** with the world of policy-making. To do this implies more than the presentation of the results in a more easily accessible form towards the end of the projects, at workshops or by other means. It is particularly difficult for work of the kind carried out in ARRPEEC to find resonances with policy makers unless they have some involvement in the course of the work, and perhaps some sense of ownership although it would be expected that some senior investigators from some NRIs do operate at a policy-making level.

Policy-makers will look for ways in which the results impinge upon norms, regulations, principles and decision-making procedures. The results from research will commend themselves to policy makers because they might reduce uncertainty and therefore risk; because it offers an expectation of consensus; because it identifies key problems and defines realistic and equitable solutions; because it helps with agenda and target setting that will form the basis of policy formulation. They will look for a maximization of benefits through any changes suggested by the research. In presentations that have been given with policy makers in mind, the complexity of this nexus seems to have been poorly realized. Thus, to "properly communicate" with policy makers is a taxing process going far beyond the mere "explaining" or "making available" results. It often requires involving policy makers at regular intervals through the course of the work. How this might have been done will vary from country to country but possibly some form of research steering committee that included research leaders and policy makers, reviewing work periodically, might have begun to involve decision makers in a way that would have made them co-proprietors of the work and both receptive and eager to implement some of the results of the studies.

Mention should also be made of the reporting and dissemination of results at workshops, seminars, and project meetings. These have been held at both AIT and in individual countries mostly with the participation of other NRIs from the different projects. This has served as an opportunity for the exchange of experiences and enhanced overall co-operation, between NRIs and with AIT. This was evident at the Annual Review Workshop in September, 2003 (see Annex 1).

4. ARRPEEC Linkages

ARRPEEC is a programme of research that operates at several levels of significance. These include important findings at the country level, results that impinge beyond national boundaries and are of significance for the Region as a whole and as GHG emissions are global in their effect, in the wider international sphere. Thus there are important linkages between ARRPEEC and these regional programmes and international initiatives although not expressed in the documentation. Relevant regional programmes are now considered and the research work then put in its overall international context.

4.1 Regional programmes

There is no shortage of research programmes and initiatives in Asia in the area of energy-environment-climate, but only ARRPEEC addresses all three in a highly inter-linked manner. Several are supported financially by Sida and find a home, at least in part in AIT. Unfortunately, information is not available to assess the cost effectiveness of the various programmes comparatively, particularly in relation to ARRPEEC.

Renewable Energy Technologies in Asia, RETs in Asia. This is a research and dissemination programme supported by Sida and co-ordinated by AIT. The first Phase of the Programme investigated three technologies: solar photovoltaic, solar drying and biomass briquetting, was carried out between 1996 and 1998 but in the context of rural environments. A second phase was run between 1999 to end 2002 and a third included studies on barriers towards the adoption of suggested technology options and dissemination of results is in effect from 2002 to 2004. The structure of the Programme is to a large extent similar to the ARRPEEC programme. RETs has a coordination unit at AIT and a networking with regional NRIs cooperating on research, capacity strengthening and dissemination of results.
There may be more contacts than it is possible to appreciate from the reports. However, if there were to be regular communication between these two programmes, such communication would result in mutual benefit.

Strategic Planning and Management of the Energy Sector in Asia. The UNESCAP, with its headquarters in Bangkok, is implementing a project to strengthen national capacity in strategic planning and management of the energy sector. The United Nations Development Assistance (UNDA) and the government of the Netherlands fund the project. The project focuses on integrating environmental and social issues into energy development and is developing tools for this and a framework to formulate policies and to implement these policies. The project consists of three phases, development of guidelines, training of trainers, and during the current phase national teams are conducting analytical work to identify strategies to shift towards adopting strategic planning and management. Exchange of experience and co-operation between this project as well as other UNESCAP projects such as *Integration of Energy and Rural Development Policies and Programmes* and *Electric Power in Asia and the Pacific* and a project to be initiated entitled *Promoting Sustainable Development Partnerships for Implementation of the Kyoto Protocol in the Asia-Pacific Region* could be extremely fruitful to ARRPEEC and to all concerned and this needs to go beyond sending out booklets to appropriate agencies. The countries participating in the ARRPEEC Programme are all members of the UNESCAP.

Regional Air Pollution in Developing Countries (RAPIDC) is a Sida supported programme by which developing countries in southern Asia, and Africa are given access to European and North American experiences of air pollution control. Participating research organisations include Swedish universities and research organisations, and intergovernmental agencies and research organisations in Asia and Africa. The programme is coordinated by Stockholm Environment Institute, SEI.

A project within the framework of RAPIDC that should be highly relevant to ARRPEEC and in particularly to the Urban Sector project under ARRPEEC is the *Air Pollution in the Megacities of Asia, APMA*. UNEP and WHO, in collaboration with the Korea Environment Institute and SEI initiated this project in 2000. The project that is funded by the Korean Ministry of the Environment and Sida is focuses on the development of policies to address urban air pollution in Asian Megacities, by increasing the capacity of governments and city authorities to deal with urban air pollution issues by developing regional action plans and establishing an urban air pollution network for Asian Megacities. Sixteen Asian Megacities, including among others Bangkok, Beijing, Manila, Mumbai and New Dehli are participating in the work

Links are established between the APMA and the World Bank initiative *Clean Air Initiative for Asian Cities, CAI-Asia*. This programme aims at promoting the sharing of knowledge and experience on air quality management, improving policy and regulatory frameworks at the regional level, piloting projects to encourage innovation, and assisting cities in implementing integrated air quality strategies. Among the participating city members are Hangzhou, China, Mumbai, India, Colombo, Sri Lanka, Bangkok, Thailand, and Ho Chi Minh City, Vietnam. As the work within this network includes promotion of formulation and implementation of air quality strategies, consultation on a strategic framework for air quality management and clean air training, contacts for co-operation and interaction would have been very useful for the participants of the ARRPEEC Programme.

In one other respect, RAPIDC holds a lesson for ARRPEEC. It is the use and success of policy dialogues whereby researchers and policy-makers engage in round-table discussions to move research findings into the realm of specific policy formulation and acceptance at a multi-national level. The Malé Declaration on the Prevention and Control of Air Pollution in South Asia and its Likely Transboundary Effects was adopted in 1998 by Ministers of Environment of all eight of the South Asia Co-operative Environment Programme (SACEP) countries.

Also of relevance to ARRPEEC is Asian Regional Research Program on Environmental Technology (ARRPET), particularly its component project AIRPET, both network initiatives where NRI and AIT research are co-ordinated by AIT. AIRPET attempts a comprehensive assessment of air pollution status, appropriate air pollution control technologies and the development of modelling tools for integrated air quality management. ARRPET is funded by Sida.

The reviewers were surprise to find that in the ARRPEEC reporting there was so little cross-reference to the programmes and initiatives described above.

4.2 International initiatives and ARRPEEC

4.2.1 UNFCCC

The United Nations Framework Convention on Climate Change (UNFCCC), the Kyoto Protocol and the Intergovernmental Panel on Climate Change (IPCC) define mitigation of GHGs, in their reports as an "anthropogenic intervention to reduce the sources of GHGs or enhance their sinks". The UNFCCC further recognizes six sectors as crucial for mitigation of GHG emissions as well as adaptation to climate change (energy; transportation; agriculture; forestry; industry; and waste management sectors). But as has been recognised, to what extent the different sectors have been prioritised depends on a number of national factors such as access to natural resources and the environment, the economic and social situation, technological infrastructure and also, of course, demographic factors.

At a regional workshop for Asia under UNFCCC auspices, the role that technological innovations would play as a force in GHG mitigation was an aspect discussed. The workshop recognised that as for many countries in the region, such as Vietnam and India, biomass constitutes an important role in the

energy system and improved cooking stoves for the rural population or the provision of alternative fuels for cooking might be more relevant than replacement of fossil fuels by adopting high-cost clean technology. For countries such as Indonesia and Thailand the workshop recognised that the major share of GHG emissions come from transport and power generation. Thus this is where investments in Environmental Sustainable Technologies, in order to mitigate GHG emissions, would be meaningful. This is not reflected or referred to in the ARRPEEC documentation.

Discussions within the framework of the UNFCCC as well as at the WSSD in Johannesburg 2002, have identified as country priorities not only sectors where activities would have an important impact in mitigating GHG in the region but also several priority areas to achieve this. Examples from those discussions are:

- the energy sector: power generation, renewable energy, and energy efficiency;
- the transport sector: adoption of cleaner fuels, new vehicle technologies, and application of public transport systems;
- the industry sector: clean production technologies, end-of-pipe treatment for industrial wastes, and application of energy efficiency;
- the rural development sector: provision of alternative fuels for cooking and heating.

Another identified priority area for GHG mitigation is increasing the rate of afforestation, thus increasing the "sink" capacity of the country.

The need to clearly identify the *country priorities* has been demonstrated, both at UNFCCC sittings, at the WSSD in Johannesburg and other relevant UN meetings. Country priorities also have to guide the process of identifying Clean Development Mechanisms (CDMs). The four different projects under the ARRPEEC, in particularly during Phases II and III, the "Biomass Energy in Asia, Assessment and Strategy Formulation", the "Small and Medium Scale Industries in Asia, Energy, Environment and Climate Interrelations", the "Strategies for Promotion of Energy Efficient and Cleaner Technologies in the Urban Transport System", and the "Strategies for Promotion of Energy Efficient and Cleaner Technologies in the Power Sector", all clearly reflect some of the country priorities within the framework of GHG mitigation to combat climate change. For the Programme to achieve the intended impact it is, however important to develop a strong policy base.

The projects have, to a varying degree, undergone an evolution from an initial technological stage, in which methods of achieving a higher degree of energy efficiency and a lower degree of environmentally harmful emissions from the sector was developed, to a stage dealing with barriers towards the adoption of best possible options in the energy-environment-climate interface. In this work, scientists from other disciplines than the real technical ones need to be involved, to a degree varying between different countries. But to be able to overcome the barriers identified (and some of those not yet identified) not only social and economic scientists need to be recruited but also policy- and decision-makers, that is those who take the steps to implement the more favourable options identified. However, the documentation from the four projects show very little involvement of policy- and decision-makers, not even at the final stages of the projects, although it may have taken place more than was reported. This is an apparent weakness of the programme that will be addressed in the conclusions and recommendations.

4.2.2 IPCC

The Special Report on Emissions Scenarios (SRES) from Working Group III of the Intergovernmental Panel on Climate Change (IPCC), published in 2000[4] presents new scenarios of possible future devel-

[4] IPCC (2000). Special Report on Emissions Scenarios. Cambridge University Press, Cambridge.

opments and indicates greenhouse gas emissions associated with such developments. These emission scenarios should be seen against a background of their use to drive global circulation models used in developing climate change scenarios, including mitigation and adaptation strategies. The scenarios are useful in providing insights of linkages between development choices and environmental quality and thus are extremely apposite for a programme that deals with energy, environment and climate in a regional group of developing countries such as ARRPEEC. The Terms of Reference of the Evaluation makes reference to the relationship between ARRPEEC and activities that would stem from the IPCC Special Report on Emission Scenarios in attaining CO_2 stabilisation scenarios.

The SRES scenarios are concerned with the driving forces of future emissions (all species of GHG and sulphur), these are demographic, technological and economic developments, and their interrelationships. They originate in scenarios that were available in the literature. From these are "extracted" a number of broad storylines that describe alternative futures. They are not predictions and no statistical probabilities may be attached to different scenarios, or many of the features within them. They attempt to give internally consistent accounts of "what if?" development follows a designated path. None include any additional, specific climate initiatives although emissions are obviously affected by a range of non-climate change policies in a number of development areas.

From 40 SRES scenarios, six illustrative scenarios, one each from three of the storylines and three from the fourth storyline, the so-called A1 storyline. It is the three A1 scenarios that are of most interest in the context of the ARRPEEC study as they are concerned with the development of alternative energy technologies: a fossil-fuel intensive scenario (A1FI), a balanced energy use scenario (A1B) and a scenario assuming predominantly non-fossil fuel use (A1T). These scenarios assume high rates of economic development and technical change so are particularly appropriate to Asian developing countries where conventional energy consumption has shown an increase of 33 per cent during 1991–2000 (compared with 12 per cent growth of World consumption). A substantial degree of capacity building is seen as accompanying the technical change.

The SRES study divided the World into four regions one of which was "Asia", all developing (non-Annex 1) countries in Asia excluding the Middle East. Emission estimates for the scenarios, including A1, are disaggregated by region and Asia is seen as having dominant fossil-fuel and industrial emissions. Future research in ARRPEEC should make a detailed analysis of the assumptions for Asia predicated in the three SRES A1 scenarios, and the emission values that result from these. From the results already obtained the correspondence between the ARRPEEC findings in specific areas and the features that are developed in the three scenarios can be compared for their compatibility. For example, does the research so far on the feasibility of developing and funding the three most promising biomass options suggest a movement along the A1FI, A1B or A1T pathways to be the most likely? Similarly with the issues investigated in the power sector (specifically, least cost supply-side options for mitigating GHG and the development of the contribution of independent power producers and decentralized power generation). Which trajectories are realistic options for Asia? Will clean technology development possibilities in small and medium scale industries have any discernible effect on overall matches to specific scenario pathways? And will likely or possible changes in urban transport systems occur to such an extent as to suggest one or other of the scenario pathways seem more likely than others?

In other words, by the time the next Phase of ARRPEEC is initiated an overall assessment of the research results of Phases I-III should provide the opportunity to evaluate the potential direction of development in terms of energy systems and consequent emissions and whether these are conformable with elements of one or other of the three SRES scenarios A1FI, A1T or A1B.

5. Policy-making and implementation

Throughout this evaluation report, as in the evaluation of Phase I of the Programme, the importance and complexity of moving from research to the process of inserting the results of the research into a policy framework that is capable of being implemented has been stressed.

Policy-making within the interface of energy-environment-climate and its relation to mitigation of GHG and climate change is, of course, mainly built at government level. However, synthesised results from good scientific projects that would lead to proposals, which if implemented might have a positive impact, thus retarding climate change and its adverse effect, could and should be used to make policy-makers aware of what is technically feasible and is thus, at least theoretically, an option that can be implemented. The best way of moving in this direction would be by involving policy- and decision-makers as partners in programmes.

A way for scientists to make available research that might commend itself to policy-making is for there to be, at the core of the research programme some form of joint steering committee, that will regularly review research results and their implications and map out the possible future direction of the research. Roundtables dedicated to the Energy-Environment-Climate nexus could have a policy influence if designed in the right way: to include research leaders, policy-makers and administrators, at the senior executive level. Round tables have a history of relative success in transferring the results of research to the policy arena in the field of natural resource use and the maintenance of biodiversity, the control of mining and its effects, air pollution control and the regulation of industry. This could be an avenue for ARRPEEC to follow in a possible Phase IV to ensure links between technical options and policy making but there are also other options.

It would, however, also be important for members of the scientific team at AIT as well as from the NRIs to be able to co-operate with other regional experts on ARRPEEC-related issues in the Asian region, thus being able to discuss results and providing an input to policy-making in a number of ways.

UNESCAP, under its Energy Resources Section, undertakes projects in Strategic Planning and Management of the Energy Sector, on Capacity Building, on Integration of Energy and Rural Development Planning, on Regulatory Measures for Promotion of Energy Efficiency, on Renewable Energy Technologies and in other fields. The UNESCAP Energy Resources Section together with the Environment Section is in the process of initiating a new project entitled "Promoting Sustainable Energy Development Partnership for the Implementation of Kyoto Protocol in the Asia-Pacific Region", which seems to be of real interest to the ARRPEEC programme and its development.

In 2000, UNESCAP held a high-level regional meeting on Energy for Sustainable Development at Bali and adopted a Bali Declaration on Asia-Pacific Perspectives on Energy and Sustainable Development as well as the Sustainable Development Action Programme, Strategies and Implementation Modalities for the Asian and Pacific Region, 2001–2005. This document might be seen as policy guidance for promoting the implementation of a supply- and demand-side energy efficiency programme in the region and promoting the application of renewable and other clean energy technologies and would be an important area for ARRPEEC to embark upon.

At the regional workshop under UNFCCC in 2000 "Transfer of Technological Consultative Processes. Asia and the Pacific Islands" (the results described under the section on GHG mitigation) policy-makers as well as governmental designated scientists participated from, among other countries, China, India, the Philippines, Sri Lanka and Thailand, all countries involved in ARRPEEC.

The ARRPEEC documentation does not refer to any exchange with other scientific programmes or policy meetings except for the presentation at the New Dehli COP-meeting of the UNFCCC. As issues subject to negotiations and discussions at the UNFCCC regional workshop as well as the projects under UNESCAP should be very relevant and of great interest to the ARRPEEC-programme, in particularly from the perspective of disseminating results for scientific discussion and influencing policy makers, this seems strange. The UNESCAP Secretariat is situated in Bangkok! The possibility of the ARRPEEC team presenting their results to other scientists working on closely related projects and through the channels mentioned above would broaden the possibility for discussion of the results with policy-makers and these avenues should be investigated. Enhanced interaction seems a valid objective even if some presentations, of which the evaluators were not made aware, took place. A stronger communication with the Energy and Environment Sections at UNESCAP would be highly desirably, should the ARRPEEC programme move into a Phase IV.

6. General conclusions and recommendations

The evaluation will consider the overall programme achievements and performance and then move to specific recommendations for the continuation of Phase III and some recommendations, and alternatives, for a possible Phase IV of the Programme.

6.1 Overall achievements and programme performance

The evaluation team finds that ARRPEEC, from its initial rationale and choice of themes, and the subsequent evolution of the programme, has been an attempt to address energy-environment-climate issues in the region in a highly relevant way. The 1998 evaluation also recognised the relevance of the programme with its initial selection of themes. The programme themes subsequently selected for Phase II and further developed during Phase III were a logical development and extension and the addition of the Urban Transport theme was a sensible addition to the themes and has enhanced the overall programme.

The 1998 evaluation found the programme, during its first phase, in part, to be insufficiently integrated with related activities at the national and regional levels. This, unfortunately, still is true. The documentation does not give enough evidence of programme exchange with other relevant and important scientific programmes in the region, neither within the energy-environment-climate interface nor with other ongoing national climate convention related programmes. Although some of the scientists, mainly within the AIT team, are developing contacts and exchange with other scientific programmes, this is largely on a personal basis and has not been of as much benefit to the ARRPEEC as would have been the case if the contacts and exchanges had been an integral part of the Programme. The programme, although now in a very policy relevant Phase III, has only co-operated with and involved regional or national decision makers to a minor extent. This means that suggested technical and policy options and strategies for GHG mitigation, however valid and feasible they are, will, with few exceptions, have little input to national policies within the region.

The objective set up in the initial document and subsequently changed to reflect the evolution of the project has, to some extent, been met. What can be seen as still outstanding for the programme is to provide a linkage of project activities in the participating countries with national, regional and global initiatives for reducing GHG and other hazardous emissions. And it is the view of the evaluation team

that only "disseminating results of the programme among policy personnel with a view to creating an impact on policy making" is unlikely to achieve any tangible policy changes. The 1998 evaluation found the objectives too vague to provide proper guidance for the programme. The current objectives are more specific, with an emphasis on capacity enhancement and linkage to policy-making, as suggested in the 1998 evaluation. Specific recommendations are made in this report (Section 6.2) for engagement in the policy process in a more pro-active way.

From a capacity building perspective, the Fellowship Programme is supposed to be the most important component. From the documentation it has, however, been difficult to find out to what extent this been achieved its goals, as there are no reports from the training programmes and few from the fellows participating in the programme. However, the co-operative efforts within the networks of NRIs participating in the different themes, is contributing to the enhancement of research capacities. This is particularly true for those persons from the different NRIs participating, and hopefully they are transmitting the enhanced capacity to their respective research institutes. As workshops and seminars have been arranged in all the different countries such influence should have been facilitated.

As was already recognised in the 1998 evaluation, the productivity of the programme was impressive. The outputs for Phase II and part of Phase III are in some respects, overwhelming. 500,000 words cannot easily be retained as an overall impression for evaluation purposes. The reports, scientific articles, several of them published in international publications with peer reviewing and other publications, including the booklets on ARRPEEC for the individual countries, are mostly of high professional standard although the analytical parts are very seldom developed into any synoptic evaluation that could have served the policy aspects better. The scientific standard is quite different between the more technical research work and the much weaker policy-oriented research, which might hamper interrelationships with policy-makers.

The special publications on individual industries, the Newsletters produced relating to the SMI theme, the booklets for the individual countries and as a comparative studies for work up to Phase III, and indeed the presentation held at COP 9, in New Dehli, 2002, are early attempts at targeting policy-makers. The themes should now include a policy directed component and specific recommendations on this are included in Section **6.2**. But the dissemination of a huge quantity of scientific information, no matter how high the quality, is not sufficient, even if the dissemination takes place at national seminars. To be more effective, a higher involvement of policy- and decision-makers during the research work would enhance the possibility of take–up of the results and their implementation.

The documentation at the disposal of the evaluating team does not include sufficient budgetary detail, nor has it been possible to obtain the budgetary details, of other relevant research programmes in the region. It has thus not been possible to make a detailed appraisal of the relative cost-effectiveness of the programme in comparison to other programmes. However, what is clear is that there should have been far more opportunities for interactions between programmes that often had very similar, and complementary objectives.

Comparisons between the budget of Phase I and the suggested budget of Phase III show a higher proportion is allocated to NRI work in Phase III and the inclusion of a specific budget item to meet dissemination. This should ensure a greater NRI research participation and, perhaps, innovative ways of transmitting the result of the Programme.

The broad cost estimates for ARRPEEC, including its activities and outputs, seem quite reasonable and a very general comparison with other similar activities indicates that the cost-effectiveness is acceptable.

The overall conclusions of the evaluation is therefore that:

- The Programme themes of Phase II and subsequently in Phase III are highly relevant in the perspective of energy-environment-climate as well as for GHG mitigation from a UNFCCC perspective for the region and its continued evolution.
- The objectives for the Phase III of the Programme were formulated for the Programme to meet the needs within the region and have not yet been achieved. A weak part is the targeting and co-operating with policy- and decision-makers. The technical options, strategies for GHG mitigation and policies so far formulated as a result of the Programme are reasonable for the region.
- The Programme has produced an impressive amount of results of a generally high standard. However, much of the extensive technical reporting would have benefited from a more condensed format, including less background documentation and more on findings and their synthesis. Scientifically, the weak part is the policy-oriented research where also an interaction with other programmes in the region and with policy-makers is lacking.
- The capacity building part of the Programme, mainly within the Fellowship Programme short training courses (1 month) or short research exercises (1–3 months) has not been reported on. It has not, therefore, been possible to report on results or their quality. The involvement of NRIs in the programme in the longer time-perspective under Phase II and III is increasing their research capacity.
- From a general perspective the trend in funding of the Programme is seen appropriate in comparison between the Phases I and III, in particularly concerning funds allocated for the research within the NRIs and thus their possibilities for capacity enhancement.

6.2 Recommendations

It has been emphasised that the evaluators consider ARRPEEC has many merits. There are also some weaknesses which, in the opinion of the evaluators, could be addressed if Phase IV sharpened the focus of the research and took vigorous steps to involve policy makers, and others as part of the research process. Some of the weaknesses were already perceived in the 1998 evaluation and the Programme is now in the process of addressing policy issues by identifying barriers towards the adoption of least energy consuming/best environmentally friendly options for the different themes. There is not always an evident link between the different technical options and the barrier analysis. There is little involvement of policy-makers and makers in the Programme; the mere dissemination of results will not enlist the commitment of the appropriate agents of change in policies. Also there are few obvious links to other relevant ongoing Programmes in the region. The capacity enhancing component seems to have been addressed, although it is not possible to assess how well it works. The success of the Programme would depend on the ability to produce high quality research results not only within the technical parts on the Programme but as much in the policy generating parts and for the interlinkages between these. Further the dialogue with policy- and decision-makers, that was recommended in the 1998 evaluation, would need to be vigorously enhanced through new initiatives and established policy making- processes.

The recommendations from the team can be divided in two. For a fruitful finalization of Phase III there are the following recommendations:

- To ensure clear linkages to other relevant programmes in the region for mutual benefit, through appropriate meetings, workshops or other means. This will ensure a clear regional focus on the outcomes of the Programme.

– Reporting on the Fellowship Programme, that includes training courses and research activities, should be given priority so that the participating Fellows and their respective NRIs have inputs into the process.

– To involve more systematic peer review of all major publications, including policy- oriented research publications, to ensure a format and presentation in these publications that optimize their impact and usefulness.

– To ensure a publication strategy that can be used for all the different themes. Such a strategy may include a database for background data (to decrease the need to include this information in all publications, thus decreasing the quantitative publication load) and different kinds of publications for different target groups, which may include (electronic) Newsletters for a broader audience.

– To ensure clear links between the technical research and the policy-oriented research, including the barrier analysis, and to involve policy-makers more directly in the Programme.

– To involve policy- and decision-makers to a higher degree in discussion and implementation of the dissemination strategy in order for the Programme to achieve the desired policy impact.

A possible Phase IV of the Programme should provide useful inputs to the countries' efforts under the UNFCCC in the area of climate change mitigation. To achieve this the evaluators recommend to the ARRPEEC team that:

– The research focus should be narrowed and concentrate on research that emphasizes means of GHG mitigation. Just as the PAH work was subsumed into another project in moving from Phase I to Phase II, in moving from Phase III to IV, the philosophy should be that if successful action is taken to reduce GHG emissions, benefits in terms of lowering emissions of other, local pollutants will accrue.

– Part of the focus on GHG should be on capacity enhancement for building the capacity for the eventual identification and prioritization of specific CDM projects, not just in the power sector but across the board of the whole programme, where this is appropriate. **This is a recommendation to now think strategically and make choices from within the four projects as a whole in order to prioritize elements**. The aim would be to enhance capacity to a level where it would be possible to specify individual CDM projects in detail to the point where they could be presented, eventually, in a form for permits to be assigned, once other formalities had been completed. Agents from potential investing countries need to be identified. The consideration of this is already well-advanced in *Annex II, Volume IV of the Phase II Draft Final Report.*

– To involve AIT, the NRIs and policy- and decision-makers from the participating countries in the prioritization Phase.

– At the initialization of Phase IV establish clear links with other relevant programmes in the region, including regional programmes of the UNFCCC and relevant programmes under the UNESCAP for exchange of experience during the full programme phase to mutual benefit.

– To carry out an analysis of the research results and likely outcomes so far in the light of certain 'SRES' scenarios (A1F1, A1T, A1B).

– To integrate the training- and research programme with the themes under the new Phase and to ensure that the results linked to the Programme will be reported in such a way as to increase the capacity not only of those participating in the Programme but also other relevant groups at the NRIs.

– To establish a general publication strategy that should be used for all the themes under this phase under which appropriate outputs are defined for the different target groups. Peer reviewing, as appropriate, should ensure the continued high scientific standards of the outputs and optimize their relevance to a range of target groups.

– Consideration should be given to setting up Steering Committees for each of the four projects that would include representatives of the researchers, policy-makers from government and representatives of commercial interests. The Committees should review the research carried out so far and agree priority areas for further work.

– Consideration be given to how a series of round table meetings, or policy dialogues, could be instituted. Decisions would have to be taken on whether these round table meetings should be established on a country level or regional level and whether they should consider all four research themes together, or separately. It would be advisable to recruit expertise both from within the Region and from outside.

– An alternative to policy dialogues and a round table approach would be to commission a synoptic report on the major significant research findings from the Principal Investigators for the four projects. This report would concentrate more on integrated findings and less on specific results for the four project areas and would serve as a "position paper" submitted to a specially constituted **Advisory Committee.**

– The **Advisory Committee**, that should be small and interdisciplinary and comprise specialists such as policy analysts and decision-makers, energy economists and the principal investigators, should be operative both during the initiation and the continued work of the new programme phase and play a key role during review workshops ("performance audits"). Initially, the Advisory Committee should be charged with preparing a draft programme proposal for Phase IV. This proposal would utilize the "position paper" prepared by the Principal Investigators as a starting point to formulate an enhanced policy-oriented and economically feasible Phase IV. Examples of elements that might be a starting point for the Advisory Committee are given below.

– A regional workshop would subsequently be organized to consider the new programme proposal for Phase IV. This workshop would include participation from Sida, representatives of other energy, environment and climate change programmes in the region (including at the UNESCAP), and stakeholders (including government officials, industry and power representatives, NGOs, and other researchers). The purpose of this workshop would be to assess the proposals for Phase IV, suggest other inputs and finally give a form of 'legitimization' for the new phase. The intention would be to broaden Phase IV of the Programme by ensuring a significant contribution by relevant policy- and decision-makers and to include economic considerations of energy systems. A broader scope of the Programme Phase IV would also contribute to enhanced capacity in the region to address issues of importance for those countries within the framework of the UNFCCC and the Kyoto Protocol.

– As the ARRPEEC programme has proven its value in the energy-environment-climate arena, where it is unique in Asia; this is an area that is of importance for climate mitigation within the framework for undertakings under the UNFCCC and it is now essential that in the discussions leading to the next phase of the Programme there should be capitalization on the technical research results. These results have demonstrated how increased energy efficiency and reduction of fossil fuels in the energy sector in Asia, both for industry, power and urban households, and the transport sector, might enable GHG mitigation to be achieved in a practical manner. The next phase of the Programme should adopt a more integrated and strategic prioritization to the selection of topics for continued research support, based on a mix of measures that are targeted to attain optimum mitiga-

tion. Consideration might be given to elements such as the Industry project, which concentrated on five small and medium-sized industries that showed promising potential; and the Power-sector that investigated relatively smaller power systems and was able to identify projects that might develop into CDM projects. These should serve as a starting point for a more integrated approach during the next phase. The urban transport project might identify more significant GHG mitigation by concentrating on some of the rapidly growing secondary cities or suburban areas where it is likely that significant results are achievable. The Biomasss work might make a contribution by concentrating on specific, medium-sized projects where progress might be easier to achieve. Such considerations by an Advisory Committee would enable Phase IV to continue the Programme evolution to a co-ordinated, regionally focused research effort that is able to have maximum policy impact.

Annex 1: Terms of Reference

Terms of Reference for the Evaluation of the Sida-supported "Asian Regional Research Programme in Energy, Environment and Climate (ARRPEEC)"at the Asian Institute of Technology (AIT) in Thailand

1. Background

Over the past several decades, the scientific community has arrived at a consensus that the earth's climate is being changed by human influences, most importantly the release of carbon dioxide (CO_2) and other "greenhouse gases" (GHGs) into the atmosphere. The most recent estimates by the Intergovernmental Panel on Climate Change (IPCC) indicate that, under a "business as usual" scenario, the average global temperature will rise 1.4 to 5.8 degrees Celsius by the end of the 21st century. This is a significant change: the high end of this range is equal to the change in the average global temperature associated with the end of the planet's last ice age, 10,000 years ago. But, during that ice age, it took thousands of years to reach this level of warming — not just one century.

The conference of parties (COP) to the UN Framework Convention on Climate Change, FCCC, held in Kyoto in December 1997 has recognised once again the urgent need to address the issue of climate change and established greenhouse gas (GHG) emission reduction targets for industrialised countries. Also, the developing countries are expected to identify GHG emission mitigation options compatible with national development. Considering that reducing global GHG emissions are likely to be achieved at a lower costs by undertaking (through anticipated international funding *inter alia* within the framework of Clean Development Mechanism) mitigation activities in the developing countries, there is an urgent need to identify country specific major mitigation options (as well as important adaptation ones).

In view of the growing importance of energy-environment-climate (EEC) issues, capacity mobilisation and strengthening in the developing countries has assumed particular importance because of the need to identify/formulate GHG mitigation projects, enhance technical backup and provide guidelines for policy making.

Starting in 1995 Sida supports the Asian Regional Research Programme in Energy, Environment and Climate (ARRPEEC) which is co-ordinated by the Energy Division of Asian Institute of Technology (AIT). The Programme is organised as a regional network involving today 22 national institutions from eight countries: China, India, Indonesia, Malaysia, the Philippines, Sri Lanka, Thailand and Vietnam.

The first and second phases of the Programme started in 1995 and 1999, respectively. The Programme has been evaluated in 1998 by J M Christensen and G A Mackenzie (Sida Evaluation 98/12).

ARRPEEC's third phase is a logical continuation of Phase II, began in 2002. ARRPEEC has focused on assessing and forecasting greenhouse gas (GHG) emissions by the transport, power, industrial and biomass sectors, and on working out various GHG mitigation options open to these four sectors. The research is multi-disciplinary involving scientists, engineers and economists. It involves technology assessment, techno-economic assessment, input-output and scenario analyses and policy analyses.

ARRPEEC analyses and findings have provide government policy-makers with realistic and applicable options and scenarios for GHG mitigation, showing how these will simultaneously lead to dramatic improvements in the local physical environment (e.g. through reduction in urban air pollution), i.e. highlight the win-win character of measures to mitigate GHG emissions.

Besides generating policy-oriented research outputs, the Programme is geared to mobilising and enhancing research capacity in energy-environment-climate issues at the national research institutes and to provide inputs into energy-environment policy processes at the national level.

From a climate change perspective, it would be important to:

(i) assess how far and how well ARRPEEC has addressed the question of GHG abatement (technology options and mitigation potential in the sectors considered) in the Asian countries involved in it and

(ii) propose changes in the ARRPEEC approach and programme so that ARRPEEC would be more closely geared to the mitigation-adaptation strategies that the Asian region will be called on to consider in the light of the ongoing and the expected future intensification of climate change and the undertakings under the UNFCCC and the Kyoto Protocol.

2. Purpose and Scope of the Evaluation

An evaluation of the ARRPEEC is suggested with the purpose to:

1) assess how far, over the last five years (1999–2003), the programme has been able to fulfil the objectives for research, dissemination and capacity strengthening tasks set out for the second and third phase of the programme (1999 and August 2001 proposals).

2) obtain views and recommendations for future direction, scope, content, functioning and funding of ARRPEEC.

3) When later received, assess the new draft application by AIT to Sida for possible continued support.

The evaluation serves as background information to the ARRPEEC network for future development of the programme.

The evaluation will also serve as background information for Sida and other stakeholders in a dialogue, concerning the possibility for future support to climate change related research programmes.

3. The Assignment (issues to be covered in the evaluation)

The assignment covers the activities of ARRPEEC over the period of January 1999–September 2003. The team shall assess:

- How far and how well ARRPEEC has addressed the question of GHG in the Asian countries involved in it.
- The validity and feasibility of the GHG mitigation scenarios, strategies and policies arrived at by ARRPEEC.
- The quantity and quality of the Programme's output, including research reports and published papers and volumes.
- The contribution of the Programme to the strengthening of research and analytical capacities and competence in energy-environment and climate problems in the individual country institutions involved in the programme network, as well as at AIT and thus their contribution towards enhanced capacity to address issues and obligations under the UNFCCC and the Kyoto Protocol.

– The modes of dissemination of research results and their appropriateness, including the relevance and range of targeted recipients.

– A broad qualitative appraisal of the relative cost-effectiveness of the Programme in comparison with other regional programmes in Asia or elsewhere, to the extent that information is readily available to the evaluators through published or unpublished sources.

– The appropriateness of AIT's philosophy, structure and management to the execution of regional research programmes of networking character such as ARRPEEC

– The team shall recommend changes in the ARRPEEC approach and programme appropriate to the activities proposed by the IPCC in its Special Report on Emissions Scenarios (SRES) and for the transition from SRES to post-SRES stabilisation scenarios, and Define opportunities for extension of the ARRPEEC and its transformation into the regional Climate Change Research Programme working with research capacity building required for tackling the climate change problem and the undertakings under the UNFCCC and the Kyoto Protocol.

4. Methodology, Evaluation Team and Time Schedule

In undertaking the tasks listed under the section "The assignment", the evaluators shall employ the following methodology, to which they are invited to add complementing elements that they think are called for:

The evaluation procedure includes a study of published and unpublished written output produced by ARRPEEC over the period 1999–2003, including the programme proposals for Phase II and Phase III submitted by AIT to Sida in 1998 and August 2001 respectively. In addition they shall read relevant selected material pertaining to AIT's overall philosophy, approach, structure and management.

The essential documentation will be provided to the evaluators by the program co-ordinators at AIT.

4.1 Division of labour between the two evaluator

Given the limited time and resources available for the evaluation, we suggest that the two evaluators divide the tasks of studying the documentation and between themselves. We leave the details of the division to the evaluators.

4.2 Team and Time Schedule

The team shall consist of two experts.

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The evaluation will entail a total of 4 weeks per evaluator, (20 days, 112000SEK), spread over the period October 2003 to 28 February 2004. The Consultants shall make their own travel arrangements.

5. Reporting

The evaluators will submit to Sida, by e-mail, a single, joint draft evaluation report in English not later than 28 February 2004. Sida will send the report to the ARRPEEC co-ordinator for their comments. Sida will send these comments together with Sida's by e-mail, to the evaluators not later than 19 March 2004. Within two weeks after receiving Sida's comments on the draft report, a final version shall be submitted to Sida, electronically and in two hardcopies. The evaluation report must be presented in a way that enables publication without further editing. Subject to decision by Sida, the report will be published in the series *Sida Evaluations*.

Further the evaluators should submit the following:

(i) An abstract of about 800 words covering the subject matter being evaluated, the propose, approach and methodology of the evaluation and the major findings of the evaluations;

(ii) An Evaluation summary of not more than 1600 words for publication in Sida's "Evaluation News letters" according to the enclosed Guidelines;

(iii) Brief Curriculum Vitae (CV) of each evaluator, of about 150 words per evaluator.

The final joint evaluation report should not exceed 40 pages (16000 words), excluding annexes. Format and outline of the report shall follow the guidelines in **Sida Evaluation Report – a Standardized Format** (see Annex 1).

The evaluation assignment includes the completion of **Sida Evaluations Data Work Sheet** (Annex 2), including an *Evaluation Abstract* (final section, G) as defined and required by DAC. The completed Data Worksheet shall be submitted to Sida along with the final version of the report. Failing a completed Data Worksheet, the report cannot be processed.

The evaluation shall be discussed at Sida where the evaluators should participate and present their findings for discussion.

Annex 2: Report from First Annual Review Workshop of the Asian Regional Research Programme in Energy, Environment and Climate – Phase III (ARRPEEC III)

AIT, Thailand, 24–26 September 2003

The workshop was organised by AIT and sponsored by Sida.

The main purpose for the workshop was to review the current status of the ARRPEEC III. In the workshop the National Research Institutes from the seven Asian countries, e.g. China, India, Indonesia, Philippines, Sri Lanka, Thailand and Vietnam that are taking part in the third phase of ARRPEEC and its four projects, met. The participating NRIs made presentations on national progresses in accordance with agreed work programmes for the different projects. Further, at the discussions with the different teams from the NRIs and the AIT Research Team, coordinated by Professor S.C. Bhattacharya, for the four projects, a work-program for the final stage of ARRPEEC III was decided in order to complete the projects under this phase in time for dissemination of results before the end of 2004.

The ARRPEEC III and its four projects has been developed out of the first phase of ARRPEEC, 1995–1998, which focussed on Power, Large Scale Energy Intensive Industries, Biomass and Emission of Polycyclic Aromatic Hydrocarbons, and to a larger extent, on the second phase, ARRPEEC II, 1999–2002, focussing on Biomass, Power, Small and Medium Industries and Urban Transport. The four regional research projects and the collaborating NRIs under ARRPEEC III are:

1. *Biomass energy in Asia: Assessment and Strategy formulation:*

– Center for Renewable Energy Development, CRED, P.R. China
– Indian Institute of Science, IISc, India
– University of the Philippines, Los Baños, UPLB, Philippines
– University of Moratuwa, UM, Sri Lanka
– Department of Energy Development and Promotion, DEDP, Thailand

2. Small and Medium Scale Industries in Asia: Energy, Environment and Climate Interrelations

– Center for Environmentally Sound Technology Transfer, P.R. China
– PSG College of Technology and Industrial Institute, India
– Industrial Technology Development Institute, ITDI, Philippines
– Industrial Services Bureau of North Western Province, Sri Lanka
– Capacity Building Centre for Sustainable Development of SMEs in Vietnam, CBC, Vietnam

3. Strategies for Promotion of Energy Efficient and Cleaner Technologies in the Urban Transport System

– Energy Research Institute, ERI, P.R. China
– Indira Gandhi Institute of Development Research, IGIDR, India
– Institut Teknologi Bandung, ITB, Indonesia
– Society for the Advancement of Technology Management in the Philippines
– Institute of Environment and Resources, CEFINEA, Vietnam

4. Strategies for Promotion of Energy Efficient and Cleaner Technologies in the Power Sector

- Energy Research Institute, ERI, P.R. China
- Indian Institute of Technology, Kanpur, IIT, India
- Central Electricity Authority, CEA, India
- Christian University of Indonesia, CU, Indonesia
- Sri Lanka Energy Managers Association SLEMA, Sri Lanka
- Sirindhorn International Institute of Technology, SIIT, Thailand
- Institute of Energy, IE, Vietnam

For each of the research projects each participating country presented its progress report during the first day. During the second day coordinating discussions within each of the four project team of representatives from the NRIs and AIT took place at which measures to ensure compatibility of the research methodology and a concrete time-table aiming at finalisation of data collection and national analysis in late June/early July was discussed and suggested. At the final day these discussions were presented, discussed and a final programme agenda was decided, which is to include the final AIT analysis of the outcomes from participating NRIs for each project.

All countries except China, that had had difficulties related to SARS, had arranged national program presentations.

Biomass Energy in Asia

The AIT Coordinating team, headed by Professor Bhattacharya, and the participating NRIs had at the introduction of the project within ARRPEEC III agreed on a three issue-approach based on which the NRIs for each country should:

- Select three most promising Biomass Energy Technologies, BETs, by using detailed characterisation criteria:
- Identify and rank barriers to the deployment of the selected BETs and develop strategies to remove these barriers; and
- Study transfer of the selected Biomass Energy Technologies.

The different BETs selected included different types of improved cook stoves (for India, Philippines, Sri Lanka and Thailand), biogas utilisation (for China, India and Philippines) but also landfill gas recovery, bargasse cogeneration, paddy husk combined heat and power, and different types of biomass for power generation.

In *China*, where bargasse cogeneration had been introduced as a UNDP/GEF-project, barriers towards such methodology mainly seems to be at the financial and policy level. This seems to be the main barriers concerning introducing land fill gas, while barriers towards introducing large and medium scale biogas generation to a larger extent is to be of a more technical nature such as possibilities to include biogas projects in animal raising industries etc. In all three BETs there are of course several barriers to overcome. Some of them are also linked to possibilities for technology transfer. Important in dealing with these barriers is obvious financing for capacity building. One such capacity building project is the UNDP/GEF Capacity Building for Rapid Commercialization of Renewable Energy in China.

In *India* biogas gasifiers for power generation is a large program of the government of India and an attractive RET for CDM projects. The system has high efficiency and a high potential, in particularly in rural areas. Use of efficient cook stoves as well as utilization of biomass for cooking may result in

improvement of the quality of life and reduction of drudgery, in particularly for women. The most important barriers towards introduction of these BETs is in the use of biomass gasifiers for power generation where the high initial cost and access to continued biomass supply in an important barrier, while for biogas for cooking and efficient cook stoves are lack of entrepreneurs or local trained persons are the main ones. It thus seems as lack of financial resources and sufficient capacity are the most important obstacles.

In the *Philippines* both the ricehull-fired steam boiler and improved cook stoves show important gain of energy efficiency. The economical analysis had demonstrated a high rate of return, in particularly for the selected biogas system, and they all show, on top of the environmental benefits also considerable socio-economic benefits. The main barriers were finance-related, technology-related or policy-related. A detailed structure to overcome these barriers has been agreed, a strategy that is designed to meet the differences between the different techniques.

In *Sri Lanka* the selected BETs, improved cook stoves, biomass residue based cogeneration in industrial sector, and fuel wood gasifier energy system in power sector were all technically characterized. The ranking of the barriers showed that high transaction cost could be an important barrier, in particularly for cogeneration in industry but that lack of awareness and lack of biomass feedstock were as important barriers. Suggested measures to overcome those barriers included different activities for capacity enhancement including the establishment of an agency responsible for BET.

Also for *Thailand* the selected BETs, paddy husk combined heat and power, improved biomass cooking stoves, biomass gasification for process heat, were mainly technically characterized. Barriers identified included such as lack of successful references, complications to operate, lack of awareness but also high initial costs. The barriers have so far not been ranked.

The common problems for the participating NRIs have obviously been to receive sufficient amount of replies to the questionnaire concerning barriers, that was distributed at workshops in the different countries (except for China where such a workshop so far due to SARS has not been possible to hold), to be able to come up with a reliable analysis for ranking of the barriers and suggestion of measures to overcome these barriers. These problems are for some of the NRIs, such as for instance for Thailand, more obvious than for others. To be able to use the Analytical Hierarchy Process, AHP, and to out of that receive a reliable result, it is important to receive not only sufficient amount of replies but also a representative number of replies from the different groups. Any analysis of removal of barriers has to be built on this. Some of the NRIs noted that stakeholders need to be involved. Stakeholder involvement in the whole process is important and should be emphasised.

The third issue under this project, study of transfer of selected BETs have so far not been initiated by the NRIs. A methodology for the study on technology transfer was presented and discussed during the workshop and will be further discussed and studied by the different NRIs. It is important that in this study include preconditions for popular participation and stakeholder involvement. Another important aspect that needs to be included in all technology transfer if of course capacity building. The methodology presented could ensure that.

Small and Medium Scale Industries, SMIs, in Asia

The AIT team, for this project headed by Professors S. Kumar and C. Visvanathan, and the participating National Research Institutes had at the beginning of ARRPEEC III agreed on the following research themes for the promotion of Energy Efficient and Environmentally Sound Technologies (E^3ST) in Small and Medium Scale Industries:

– Estimation of GHG emission in selected sectors of SMIs in study countries.

– Prioritizing the barriers inhibiting the promotion of energy efficient and environmentally sound technologies, E³ST in SMIs.

– Techno-economic analysis of E³STs.

The five participating countries had selected different industrial sub-sectors that are energy intensive and/or highly polluting, common across the country, and that has economic importance in the country. The sectors chosen were the foundry sub-sector (by China, India and Philippines), the brick sub-sector (by China, India, Philippines, Sri Lanka and Vietnam), the tea sub-sector (by India, Sri Lanka and Vietnam), the textile sub-sector (by China, India and Vietnam), the ceramic sub-sector (by the Philippines, Sri Lanka and Vietnam), and the desiccated coconut sub-sector (by the Philippines and Sri Lanka).

When estimating the GHG emissions from the selected SMIs in the different countries an IPCC based methodology is used to make cross-country comparison studies on GHG emission and mitigation options possible. Such comparison has so far shown that impacts resulting from energy use and pollution load are individually small but collectively high, that the selected SMIs in general show low energy efficiency, that policies applied are not specific to SMIs, and a lack of information on technologies applied.

Data collection and verification for estimation of GHG is almost completed for the selected SMIs in the participating countries. The NRIs are now studying the barriers to overcome for the promotion of E³ST in selected SMIs. In order to do that a questionnaire has been designed and distributed in order to, by applying the AHP technique, be able to prioritise between different managerial and organisational, financial and economic, technical and information, and policy and market barriers. The responses are then to be analysed, but such an analysis requires a sufficient and representative number of responses to be useful, which has shown to be a difficulty for all the participating countries.

In *China* collection of information of energy consumption for the estimation of GHG emission in selected sub-sector SMIs has so far shown a very depressing result by only 2–4% responses out of the distributed questionnaires. To be able classify barriers inhibiting the promotion of E³ST a new questionnaire was distributed to government representatives, enterprises and experts, this time generating a much higher response, 32.5%. According to the responses a majority found policy and market barriers and financial and economic ones to be most important. A more thorough analysis is still to be done and disseminated. The techno-economic evaluation has started by distribution of a more successful questionnaire.

For *India* the estimation of GHG emissions for the textile and tea sub-sector based on data from audited factories have been completed and is ongoing for foundry and brick making sub-sectors. The questionnaire for prioritising the barriers inhibiting the promotion of E³ST has been distributed to various stakeholders, both users, manufacturers and policy makers according to what is needed to undertake the AHP analysis. The rate of responses has been fairly high due to a very active program for collection of the responses. An important aspect is also that there has been an active discussion with the stakeholders. The preliminary studies are still ongoing for the tea sub-sector but show for the other sub-sectors that the high initial capital costs together with limited service provision and some resistance towards changes at management level are the main barriers towards the promotion of E³ST. Even for the techno-economic evaluation enough responses on the questionnaire were collected, thanks to a very active collection process. Thus, based on the results a meeting of stakeholders is scheduled for February 2004, where suggested technical and policy measures to mitigate GHG emissions is to be discussed.

For the *Philippines* collection of data for GHG emissions started early but severe difficulties have been experienced, not only due to insufficient data but also due to that specific emission factors vary widely from one plant to another and that the release of funding by the Philippine government to the NRI for the study has been delayed. This delay has also influenced the barrier study and very few responses to the questionnaire have thus been able to retrieve. The questionnaires used for the techno-economic analysis of E³ST will also need more responses before a useful analysis to develop technical and policy scenarios for GHG emission mitigation can be done. Further, a closer link to stakeholders need to be ensured.

Sri Lanka has completed their GHG emission estimation for three out of four selected sub-sectors with the remark that the difference between plants of different sizes is huge which sometimes makes the estimation for the sub-sector uncertain. Questionnaires were not distributed but the barrier prioritization is analysed out of results from workshops held with stakeholders, one for each sub-sector. This collection of information showed that the dominant barriers concern financing and economic aspects, such as that environmentally friendly projects generally were perceived as resulting in higher initial capital costs as well as in an increased costs for production. Collection of responses without using a formal questionnaire may, however, aggravate an objective analysis. In the techno-economic analysis, 8 out of 11 technologies identified during ARRPEEC II have been implemented and the ranking of technologies are in progress.

For *Vietnam* policy and management changes in the NRI have made the research work very difficult. Further, this might be a reason why qualified researchers do not want to join the project as fellows, only less qualified are applying. Estimation of GHG emission at plant level has been able to do for the ceramics and the brick sub-sectors but the results are somewhat difficult to translate into sub-sector level. Attempts have been made to calculate the importance of emissions from transporting the products. To prioritize barriers a workshop with experts from policy level, research level and independent experts was held. A limited number of responses to the distributed questionnaire were received from the experts but no detailed analysis was presented. Presently the work is focussed on the techno-economic analysis of the E³ST.

An important difficulty in this projects and for the possibility to make any joint analysis and comparison of the results is the methodology for collection of information. There has to be a common structure for how the questionnaires are prepared, to whom they are sent, how they are collected to receive as many responses as possible without influencing them. The AHP methodology require some basic type of information but as information so far has been collected very differently it might still not be compatible and a final analysis might therefore be misleading.

Energy Efficient and Cleaner Technologies in the Urban Transport System

The AIT Coordinating team, for this project headed by Drs Nasrul Islam and N.T. Kim Oanh and the participating NRIs had agreed that the following issues should be addressed during ARRPEEC III:

- Studies of Air quality Impacts of the Selected Technological Options, and
- Application of measures to overcome barriers to adoption of energy efficient and cleaner technologies.

The work on air quality has to build on the identification of different technological options that has been identified during phase II. These included recording of emissions from different transportation means, sometimes with or without background concentration of the substances. Based on meteorological data and by using a dispersion model (MUAIR), concentration of air pollution in ambient air and its health impacts can be estimated. The main problem was to apply the model on the same type of

background data for the identified cities in the participating countries so that the results are comparable and can be used in a final analysis. Another problem that was discussed was application of a methodology for health impact assessments. This model was presented and discussed during the workshop.

During ARRPEEC II cleaner transportation options have been selected by application of a least cost model and barriers towards applying these have been identified. Now the participating NRIs are working on identifying policy options to address these barriers. The policy options need to be evaluated and suitable ones be recommended.

China did during ARRPEEC II work on identification and selection of different technological options to mitigate CO_2 emissions for Beijing and for Hangzhou. During the current phase a concentration of work has been on Beijing for the Beijing Olympic Games 2008 and on identifying of policy options to address any barriers towards promoting clean technologies for transport in the city. Policy options suggested include tax reduction for low emission cars, involvement of multi-investors, public participation for clean-driving and integrated development of public transportation. The MUAIR model was run for different scenarios to estimate air quality and its impacts. This is not yet finalised.

India has been working on different kind of scenarios to identify impact of the energy saving and environmentally friendly alternative transport options on ambient air quality in Dehli and Mumbai. Application of the model for the different scenarios that were presented as options to Business as Usual included a Least Cost Option that should be an environmentally friendly one, showed promising results.

For *Indonesia* the cities of Jakarta and Bandung were chosen. The concentration of local air pollutants were estimated for the following types of scenarios: Business as Usual, Selected technological options, and Least Cost Options, by applying the MUAIR model for transport and transport + other sectors. The work on health impacts and on policy options to overcome barriers has not yet been started.

The *Philippines* had collected data on vehicles and ambient air quality as well as different health aspects in Metro Manilla but had had problems applying the MUAIR model. As the methodology for estimating health aspects were only just presented and discussed, calculation of such to be compared with collected data could not have been done.

Vietnam is working on the Ho Chi Minh City where estimations of various emission pollutants from transport activities up to year 2020 are available. The scenarios/different options to be used have been identified as Business as Usual, feasible options (including least cost option) and BUS increase. The objective is to use available estimation to assess the air quality for the years 2002, 2005, 2010, 2015 and 2020. Data collection on meteorological data etc to be used for the model is finalised, as is preliminary determination of policy measures, factors and actors. Work has started on establishing matrices etc for applying an AHP analysis to be able to rank policy measures.

The work has advanced very differently for the different countries, to a large extent depending on available background material and data. Most of the countries had so far not been able to start working on different policy options to address existing barriers. It is important that that work be done in a coherent way so that an over-all analysis can be done and the result be reliable and useful.

Strategies for Promotion of Energy Efficient and Cleaner Technologies in the Power Sector in Selected Asian Countries

The AIT team, for this project headed by Dr Ram M. Shrestha, and the participating NRIs had at the introduction of the project within the ARRPEEC III phase, agreed on that the following issues should be studied:

– Identification and ranking of barriers to adoption of cleaner technologies (CTs) and energy efficient technologies (EETs) in the power sector, selected during ARRPEEC II, and of measures to overcome the barriers.

– Implications of carbon and energy taxes as instruments for GHG emission reduction in the power sector.

In identifying the barriers the methodology to be used should include a literature review and stakeholder involvement e.g. utility planners, policy makers and utility investors (but it did not include any provisions for involving the users!). In ranking the barriers the AHP methodology is to be used which requires a questionnaire to be distributed to a representative number of these stakeholders and with sufficient and representative number of responses from each group in order to be able to make the analysis.

Policy measures to overcome the barriers have to be identified in consultation with energy policy makers, power sector investigators and other stakeholders. Evaluation and prioritisation of these measures needs to be done in order for the measures to have sufficient effect on barriers of different categories, e.g. economic, financial, administrative, political (institutional barriers were not identified, which is strange). Based on an analytic evaluation, recommendations should be done.

Implications of carbon and energy taxes as instruments for GHG emission reduction should be done by importing carbon and energy taxes and technical and cost data into a long-run power generation planning model where the generation cost will influence the electricity price, which in turn influences the electricity demand and thus the long-run planning model in a loop. But application of the long-run model is also resulting in an influence on GHG emissions, technology-mix and fuel mix. Imported into an input-output model this will show economy-wide implications of carbon- and energy taxes.

China started their work in the Hunnan province but is now trying to use the methodologies to promote energy efficient and cleaner technologies for the power sector for the whole of China. As the whole of China has a large amount of power plants the application of the suggested technologies to all these takes time, as does the abatement cost analysis. The identification and ranking of barriers has been initiated but not finalised but the results so far show that high costs is an important barrier.

For *India* analysis of implications of carbon and energy taxes as instruments for GHG emission reduction show the following results: Introduction of carbon tax will result in an increase of the hydro power plant capacity mix; the selection of candidate thermal power plants having coal as fuel decreases; the total generation (MWh) decreases as the level of carbon tax and price elasticity increases; and the share of coal based power plants in per cent decreases. The work on barriers was not finalised.

Indonesia has studied the power system at the Java-Bali grid, which currently has a mixture of 13% hydro, 25% oil, 40% coal, 18% gas and 4% geothermal as energy sources. The carbon and energy tax analysis on the system showed a reduction in particularly in use of coal based electricity generation. But the analysis also showed that system changes will have a fuel mix effect, a structural effect, a final demand effect and a mixed effect. The first three of these would increase the CO_2 mitigation while a mixed effect would act in the opposite direction. These conclusions are important when addressing the barriers.

In *Sri Lanka* the work had been concentrated on decomposing economy-wide emission change of CO_2 mitigation from power sector with taxes. The candidate plants were thermal, hydropower and mini-hydro and wind plants. The analysis showed that the impact of carbon tax on emission is visible mainly through final demand and structural effects but the overall impact is not significant. Impact of energy taxes on emissions is more visible than that of carbon tax. The work on barriers remains to be done.

Thailand has been reviewing economic outlook and power generation data and made an analysis on the implication of carbon and energy taxes as instruments for GHG emission reduction under different scenarios but the results were not presented. Barriers were identified and an AHP analysis of received results (how they were obtained was not presented) was undertaken. An evaluation of different policy measures to address the barriers is still to be done.

Vietnam had had severe difficulties to collect data mainly due to organisational difficulties.

The overall work on the issues within the power project has shown good results with some exceptions on the issue of using carbon and energy taxes as GHG mitigation instruments. Few of the countries have so far been able to address the issue of barriers. It is important that this issue, as for the other three projects, be addressed with a compatible approach so that an overall analysis will be possible to undertake to achieve final results.

Summary of achievements

The third phase of the ARRPEEC should initially have been finalised by the end of 2003. However, due to different circumstances the progress has been fairly different in the NRIs in the countries participating. This means that currently it is not possible to use the country reports for the different projects for a project analysis to base any recommendations on. The analysis will therefore be postponed till 2004 and be presented within a proper dissemination process before the end of 2004. This way the results of the ARRPEEC III can hopefully impact policy and decision makers in a climate change abatement direction.

Even though the economic situation might give countries such as China and India an advantage, the size of the countries and thus possibilities to access data might still cause them problems. This was obvious in particularly for the project on promotion of energy efficient and cleaner technologies in the power sector where China and India but also Indonesia have had difficulties applying the methodology used for selected pilot areas to the whole country and its large numbers of power plants.

Institutional changes and delay of funding distribution within the country have also in some cases hampered project implementation. This was the case for the Philippines under the SMI project where funding distribution delayed the project and for the Vietnam power project where the institute was undergoing a complete reconstruction. This is of course delaying the possibility for the final analysis.

All four different projects are addressing issues of evaluating environmentally friendly and energy efficient methodologies and their contribution as GHG mitigation options in their different sub-sectors; biomass energy, energy use in SMIs, urban transport and the power sector. A lot of progress has been achieved in demonstrating how these technologies would contribute towards reducing GHG emissions, in particularly at the local or regional scale. Of course, the progress varies between the different NRIs but the exchange of results and knowledge that is ensured by AIT as the coordinator of the networks is a very important instrument that will help the participating NRIs to achieve better results. An important achievement is also that the methodologies agreed for the four sub-sector projects could be applied in the different countries with their different pre-conditions.

Another important achievement within the project is the extent to which scientists from different disciplines have been involved. Not only have natural and technical scientists been involved as in identification of CDM projects and assessment of their GHG mitigation potential or evaluation of technical options to mitigate emissions resulting in urban air pollution. Also economic scientists have participated in the different NRI-teams, e.g. for assessment of cost of CO_2 abatement by application of different biomass energy systems or identifying least-cost supply-side options for mitigating GHG emissions in the power sector, where they in several of the countries have presented useful results.

In the ranking of barriers to the adoption of the identified energy efficient and environmentally sound technologies in the four sub-sectors social scientists need to participate, as this needs to include and build on qualified policy analysis. The methodology selected is the Analytical Hierarchy Process, AHP, which includes not only calculations but also a fair amount of analytical work. So far this part is what in many cases is lagging behind, mainly due to lack of reliable data.

The most important achievement is, however, the demonstrated cooperation between different countries in the region, between different research institutes in the countries, between different sub-sectors in the energy (use-)sector, and between different research disciplines in identifying energy efficient and environmentally sound technologies and the barriers towards pursuing them to reduce GHG emissions.

Recommendations

As stated above, the ranking of barriers by applying the AHP methodology is in many cases lagging behind, mainly due to lack of sufficient responses to the questionnaire that was distributed. Not only were too few responses received, but also the ones received were often not distributed representatively for the different categories. This would make an analysis very unreliable and would, if included in a background for a final analysis for the whole region, severely jeopardise the final results. The issue was discussed in the different groups during the workshop. It is very important that within the different projects the categories to which the questionnaire is distributed are identically defined for the different countries, that the weighting system for the different categories is identical and that the analysis is undertaken in a compatible manner. Otherwise the result of the final analysis may be misleading.

The policy analysis that has been undertaken has mainly been to identify the barriers on categories such as technical, financial, institutional and informational barriers, or more detailed ones. What has so far not been done or done to a very minor extent is identifying policy measures to address these barriers. For instance the analysis of application of carbon and energy taxes under the power project deals with different means to introduce the new technology by addressing barriers from a financial point of view. For the different technologies to be able to pursue, in particularly in a larger scale, all the different perspectives of trying to eliminate the barriers needs to be addressed. This needs a larger involvement of social and maybe political scientists and should be done either within this phase of ARRPEEC or at any next phase.

Specific recommendations for the different four projects are:

For the *Biomass project* the study of transfer of selected BETs so far has not been fully introduced. The methodology that was presented during the workshop needs to be very clearly defined so that the application will be compatible between the different countries. Further, it is important to ensure full stakeholder participation and that there is a common definition of stakeholder categories.

For the *SMI project* in order to address the issue of barriers, energy and environment policies that are specific to the SMI sector need to be clearly identified. This identification would also be important when identifying how to address the barriers.

For the *Urban transport project* there is a need to ensure that the different scenarios applied for using the MUAIR model for estimation of emissions from transport and transport + emissions from other sectors are clearly defined and compatible for the final analysis to be possible.

For the *Power sector project* the application of carbon and energy taxes as policy instruments in addressing barriers is very interesting and needs to be pursued for all countries. It would, as stated above, be useful to identify and apply other measures as well. As taxes by many stakeholders are considered as a "negative" instrument, comparison with effects of incentives would be interesting and useful.

The work on the ARRPEEC III has demonstrated important progress. It is, thus, necessary that the work at the National Research Institute can be finalised by the end of June to allow for over-all analysis of the projects at the central AIT level. The results need to be ready and to be disseminated by the end of 2004. This is necessary to allow for developing of a more climate change oriented program where the results of ARRPEEC III could be used as a useful starting point. An important issue in this would be to develop different policy measures to address and to the extent possible eliminate barriers towards GHG mitigation, for the countries thus to contribute to the objectives in the UNFCCC and the Kyoto-protocol. The possibilities for such a development seem promising.

Uppsala October, 2003

Gunilla Björklund
GeWa Consulting

Annex 3: Curriculum Vitae of the Evaluators

Gunilla Björklund

Personal Details

Date of Birth: 16 June, 1945

Nationality: Swedish

Residency: Sweden

Qualifications

B.Sc.	Physical geography incl climatology, etc, Stockholm University
PhD	Uppsala University, Fluvial morphology and EIA

Key Expertise

Integrated Water Resources Management and linking to adaptation to climate change;

Environmental Impacts Assessment, including as an instrument in adaptation strategies;

Desertification processes;

Climate and environment negotiations;

Climate capacity assessment.

Professional Experience

1998–present	Environmental consultant at GeWa Consulting
1994–1997	Executive Secretary at UN/SEI Comprehensive Assessment of the Freshwater Resources of the World
1992–1994	Special Advisor, Swedish Ministry for Foreign Affairs
1990–1992	Scientific Advisor, Swedish Ministry for the Environment
1988–1990	Programme Officer, International Secretariat of the IGBP, Global Change, Stockholm
1986–1988	Assistant Professor in Physical Geography, Karlstad University
1971–1986	Research assistant, Lecturer, Assistant Professor, Department of Physical Geography, Uppsala University

Research Interests

Desertification processes as related to climate variability, physical and human induced land and water degradation.

International experience

Mauritania, Mali, Burkina Faso, Senegal, Kenya, South Africa, Bangladesh, Uzbekistan.

Languages

Swedish, English, German and to some extent French

Project Information and Publications

Experience in project management in an international perspective mainly within the UN-system and with the World Bank, at policy level and with field applications.

Around 40 different scientific publications and applied science publications including joint publications. Several consultancy reports including for Sida/SAREC on a proposal for Sida/SAREC global,

regional and national cooperation for developing country capacity development to meet with their undertakings under the UNFCCC.

Michael John Chadwick

Personal Details

Date of Birth: 13 September, 1934

Nationality: British

Residency: United Kingdom

Qualifications

B.Sc. (Hons.)	Botany with Agricultural Botany, University of Wales
Ph.D.	University of Wales, Ecology of mountain grasslands
M.A.	Agricultural Botany, University of Cambridge
F.I. Biol.	Fellow of the Institute of Biology
C.Biol.	Chartered Biologist

Key Expertise

Growth of plants on difficult substrates including the rehabilitation of degraded land;

Environmental risk analysis and assessment;

Integrated air pollution abatement modelling;

Environmental change scenarios, including climate change.

Professional Experience

1998–present	Environmental consultant
1996–1998	Director of the Leadership for Environment and Development programme for Europe
1991–1996	Director of the Stockholm Environment Institute, Sweden
1989–1991	Director of the Stockholm Environment Institute at York and Professor of Biology, University of York
1966–1991	Lecturer, Senior Lecturer, Reader and Professor, Department of Biology, University of York

Research Interests

Environmental risk analysis, air pollution abatement modelling and environmental change scenario development.

International Experience

France, Belgium, Germany, Poland, Ukraine, Russia, USA, Colombia, Indonesia, Australia, Zimbabwe, Sudan, Tanzania, Botswana, Oman, Lebanon

Languages

English and French

Project Information and Publications

Extensive experience in project management in Yorkshire, throughout Europe and in South America, Africa and Asia.

Over 120 publications including joint publications on Accounting and Accreditation of Activities Implemented Jointly (Report to the European Commission, 1999), Environmental and Social Aspects

of Joint Implementation: Methodologies and Case Study Results (Earthscan, 2001), Implementing Environmental Considerations for Joint Implementation and the Clean Development Mechanism (Journal of Environmental Assessment, Policy and Management, 2001) and Determining the Costs to Industry of Environmental Regulation (Journal of European Environmental Policy, 2001).
Review Editor for the IPCC Emission Scenarios Report and the Third Assessment Report of IPCC Working Group III (1999 & 2000).

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Arne Svensson, Tony Bennett, Gunnar Danielsson, Malena Jönsson, Stina Waern
Department for Co-operation with Non-Governmental Organisations, Humanitarian Assistance and Conflict Management

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Shinga Mupindu, Nigel Murimirudzombo, Pascal Changunda
Department for Africa

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Gordon Tamm, Michael Schulz, Åke Nihleen, Helena Lindholm Schulz
Department for Asia

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The Pilot Project for Publishing in Tanzania
Leif Grahm, Kajsa Pehrsson, in collaboration with Lipangala Minzi
Department for Democracy and Social Development

04/09 **The East African Regional Programme and Research Network for Biotechnology, Biosafety and Biotechnology Policy Development (BIO-EARN)**
E Jane Morris, Niels P Louwaars
Department for Research Co-operation

04/10 **Zimbabwe AIDS Network (ZAN)**
S. Mupindu, C. Maposhere, P. Changunda
Department for Africa

04/11 **Sharra Waste Dump Site, Albania-Feasibility Study and Urgent Rehabilitation Measures**
Karin Billing, Michael Wenborn, Lirim Selfo
Department for Infrastructure and Economic Co-operation

04/12 **Social Policy and Community Social Service Development Project in Lithuania**
Frank Bertelsen, Laimutė Zalmienė
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