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**Energy and
environment
in Asia**

Transnational and
global issues

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by

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1. INTRODUCTION

The availability of energy is an essential pre-condition to economic development. As a natural resource, fossil carbon - via the burning of fossil fuels - is a key to industrialism as we know it; however our historical production and consumption of energy has exerted major stress on the condition of the environment today. These general statements are widely acknowledged; yet we are still, for the most part, uncertain of how we will commit to long-term sustainable energy supplying of global energy needs in the future.

We know the energy sector contributed 46% to the enhanced radiative forcing of the atmosphere during the decade of the 80's, and its contribution is projected to increase to 65% in the period 2000-2025¹. Total global consumption of primary energy in the world in 1990 was 8033.3 million tonnes oil equivalent (mtoe). 3101.4 mtoe oil and 2192.1 mtoe coal² were consumed, making them the most frequently burned fossil fuels in the world and the largest sources of anthropogenic greenhouse gases (GHGs). Globally, fossil fuel use has nearly quadrupled since 1950, with the fastest growth found in the developing countries. Yet, the OECD countries, including the US, still account for slightly more than half of primary energy consumption. Developing countries account for around 25% of the total. In addition, per-capita energy consumption in developed countries is an average 10-30 times that of developing regions of the world, producing around two thirds of GHG emissions³.

While per-capita energy consumption levels could drop in the OECD countries, due to wide implementation of energy efficient technologies and stabilized population, levels in developing countries are likely to increase as development measures (especially related to electricity generation, direct

¹Intergovernmental Panel on Climate Change (IPCC) (1990), *Overview and Conclusions, Climate Change: A Key Global Issue*, Draft, July, p. 15.

²BP Statistical Review of World Energy (1991), p. 34.

³Congress Office of Technology Assessment, OTA (1991), *Changing By Degrees. Steps to Reduce Greenhouse Gases*, Washington, D.C., OTA, pp. 274 and 275.

industrial use and transportation) are implemented⁴. A combination of the factors cited, coupled with population growth, would suggest the developing countries' primary energy consumption will grow rapidly.

There is considerable variation from region to region, however, the region the world is watching most closely is Asia due to the predominant utilization and existence of large and available regional sources of coal - the most atmospherically damaging primary fuel. This paper covers some of the most relevant transnational and global energy-environment issues related to Asia.

2. ASIA - ENERGY, AND THE ENVIRONMENT

In 1990, almost 50% of the primary energy needs in Asia were supplied by coal. In China, coal supplied approximately 76% of primary energy needs in 1990⁵. Coal use causes many more environmental problems than are often recognized. Aside from contributing to the global warming phenomenon and the problem of local/regional air pollution, there are other deleterious problems caused by coal-fired energy supply. To name a few: land requirements for mine wastes and fly-ash dumps, acid mine drainage, and water shortages caused by the water used in the process⁶. The outlook for the future of coal use in Asia is alarmingly high - suggesting a future of unsustainable energy planning in the national, regional, and global contexts of the world.

The developing countries' share of world commercial energy use increased from 16 to about 25% between 1970 and 1988. China, India, and Brazil comprised about 45% of the developing world's consumption of commercial and traditional fuels in 1988, with China alone accounting for

⁴Ibid., p. 275.

⁵BP. Op. cit., pp. 29 and 33.

⁶Asian Development Bank (1991), *Environmental Considerations in Energy Development*, Asian Development Bank, Manila, May, p. 116.

30%⁷. Coupled with above (global) average burning of coal, the Asian region is also the location of the greatest population pressures. A global “doubling of energy consumption in the first half of the 21st century and an expected doubling of the population in the latter half” has been projected⁸. As the various countries in the region expand their industrial bases via development while experiencing large increases in population, energy consumption will increase.

Knowing what we do today about the inextricable links between energy and the environment, we could expect to experience further stresses to the already threatened atmosphere and ecosystems. The Second World Climate Conference clearly stated:

"Climate issues reach far beyond atmospheric and oceanic sciences, pivotal in determining future environmental and economic well-being. Variations of climate have profound effects on natural and managed systems, the economies of nations and the well-being of people everywhere."⁹.

The global climate-related environmental impacts of national energy development plans are of indisputable importance, and will be discussed later in this paper; however, transnational impacts resulting from the production, transportation and consumption of energy are abundant and equally critical in their own right. We turn to some of these now.

3. TRANSNATIONAL PROBLEMS

One phenomenon, especially relevant to Asian energy development issues, considered “beyond atmospheric” is the phenomenon of acid rain, called acid deposition, acidification, or acid precipitation in the scientific jargon.

⁷OTA. Op. cit., p. 287.

⁸Second World Climate Conference, Draft Statement, Scientific/Technical Sessions, Convened in Geneva, Switzerland, October 29 - November 7, 1990, p. 3.

⁹Ibid., p. 2.

The burning of fossil fuels is the predominant source of acid rain, though modern forestry and agriculture can be contributors as well. In brief, falling pH is the indication of increasing acidity. When pH falls by one unit the concentration of acid (in precipitation or in the contaminated bodies of water) has become ten times greater¹⁰. Anthropogenic emissions into the atmosphere contain large quantities of oxides of sulfur and nitrogen which, on average, only remain in the air for a few days and then fall back down to the earth as either wet or dry precipitation. SO₂ and NO_x are the compounds that cause the acid rain effect. In the legal and scientific literature we are accustomed to discussing this phenomenon as “transboundary” or “transnational” pollution. In the case of the vast countries that exceed the distance between contiguous countries, like India and China, one could consider acid rain as more of a “national” or “regional” problem.

The extent of acid rain is documented in detail for parts of Europe (Scandinavia especially) and North America. In other parts of the world, however, the degree is less known. To date, emissions of anthropogenic sulfur and nitrogen are substantially smaller in Africa, Australia, and South America than they are in North America, Europe, and Asia. It is expected that emissions in North America and Europe will decline (sulfur) or at least remain more or less constant (nitrogen). Asia, however, could experience a substantial increase of these emissions. China, for example, is a documented case of a regional acidification problem. Large emissions of SO₂ from coal burning in urban areas of the Guishow and Szechuan provinces cause widespread acid rain over these two provinces. Large sulfur emissions also occur in the northeastern parts of China, but these areas are neutralized by compounds such as calcium carbonate carried in airborne soil dust¹¹.

The first (Appendix 1) of the figures included in the Appendix illustrates the differences in the per capita energy consumption for the five regions of the world. It is clear that emissions of sulfur and nitrogen in North America and Europe dwarfed those of other regions in 1980. Over the course of the

¹⁰Swedish Ministry of Agriculture Environment '82 Committee, *Acidification Today and Tomorrow*, pp. 30-31.

¹¹Rodhe, Henning. Acidification in a Global Perspective. *AMBIO* Vol. 18 No. 3, 1989. p. 156.

last decade, however, the per capita emissions in North America and Europe have been reduced due to stricter controls, whereas those in Asia have become increasingly higher. It cannot be assumed that the lower per capita emission in some areas, such as Asia, leads to a lower degree of acidification of the atmosphere¹². This is especially misleading when one takes future population growth of these regions into consideration. The second and third figures (Appendix 2), then, are projections of the global sulfur and nitrogen levels respectively in the year 2020. In each of these graphs, the first bar illustrates the base year of emissions (1980). The second bar considers population growth only, with no per capita increase in emissions. The final bar considers population growth plus an increase in per capita emissions.

Since estimating sulfur and nitrogen emissions to 2020 is dependent on knowing the rate of population growth and the rate of increase in per capita energy consumption, the author of the projections made some assumptions¹³ to attain possible scenarios for the above figures. In any case, the figures make their point and are not the only example of this type of prediction. Calculations performed using a global chemistry model indicated if the per capita emission of sulfur (from burning coal) in the Asian countries, such as India and China, were to increase even moderately, very large emissions would occur and be likely to result in widespread acidification problems¹⁴. Therefore, though per capita emissions of SO₂ in India may be around 5% the figure for North America today, its effect on the local and regional environment may be very severe in the future.

Although acidification is not a global problem in the sense GHGs are, they are a serious environmental problem that can spread to neighbors, which could potentially cause regional or transnational tension. This calls for regional cooperation. In Norway we have some experience in setting up

¹²Galloway, James N. (1989), Atmospheric Acidification: Projections for the Future. *AMBIO*, Vol. 18 No. 3, p. 161.

¹³*Ibid.*, pp. 164-165.

¹⁴Rodhel, Henning, Galloway, James and Dianwu, Zhao (1990), *Acidification in the Tropics - Prospects for the Coming Decades*. (Draft) November.

regional cooperation. Scandinavia is probably the most well known victim of serious acidification of lakes. Most of the acid rain that has killed the lakes' ecosystems came from outside of Scandinavia, mostly the regions of heavily polluting industries. The Norwegian government had to struggle for many years, beginning in the 1970's, in order to persuade its neighboring countries to accept their responsibility and invest in cleaner technologies. Today we have the UN Economic Commission for Europe Convention on Transboundary Pollution. The convention, which originally set up a 30% reduction of SO₂, is presently being renegotiated for more ambitious steps.

With some of today's technologies the incidence and damage caused by acid rain can be reduced. One of the most simple to employ is coal washing or cleaning - apparent in studies from India. The coal currently utilized is mostly from open-cast mines and has a great deal of shale and rock mixed in. If the coal were washed first, the boiler efficiency would rise to about 89.5%¹⁵, which would save energy while saving the environment at the same time since both CO₂ and SO₂ emissions could be decreased, reducing the global warming threat and the acid rain threat together. There are no existing coal washing plants in India, however, due to a large extent to the paucity of capital.

There are many other mitigating technologies that exist to diminish the acid rain trend, as illustrated in the following table (Table I).

¹⁵Tata Energy Research Institute (TERI), (1991), *Estimation of Asia's and Brazil's Contribution to the GHG Emissions and Policy Responses for their Minimization*, India Country Paper, New Delhi, p. 7.

Available, Potential, and Possible Technologies for Controlling Acid Deposition

| Available | Potential | Possible |
|--|---|-------------------------------------|
| - Physical coal cleaning | - Chemical coal cleaning | - Other electricity fuel-generation |
| - Oil desulfurization | - Limestone injection multi-stage burner | - Energy Conservation |
| - Wet flue gas desulfurization | - Atmospheric fluidized bed combustion | |
| - Dry flue gas desulfurization | - Pressurized fluidized bed combustion | |
| - Regenerable flue gas desulfurization | - Integrated gasification combined-cycle technology | |
| - Staged combustion | - Magnetohydrodynamics | |
| - Flue gas recirculation | - Electron beam irradiation | |
| - Dual-register burner | | |
| - Low excess air | | |
| - Low nitrogen oxide burner | | |
| - Flue gas treatment | | |

Table I

SOURCE: Regens, James L. and Rycroft, Robert W. (1988), *The Acid Rain Controversy*, University of Pittsburgh Press, Pittsburgh.

It is also interesting to note that a good deal of these technologies would also be beneficial in dealing with the global climate change question. In assessing the industrialized or developed world's past, a visible timelag seems

evident between socio-economic development and corrective measures to deal with environmental deterioration caused by increased energy consumption, hence environmental degradation. Plans to control emission levels and to reduce acidification of lakes did not come into existence until the life in the lakes was gone in some of the regions affected. The world can not afford to make a similar mistake again now - or in the future. This call for cooperation is, of course, on a global level now, considering the threat of global warming. Nevertheless, transnational environmental effects of development and population growth should not be lost out of sight.

A considerable portion of this discussion has been devoted to the acid rain phenomenon, however other current transnational concerns in Asia merit discussion. A brief introduction to a problem related to the transport of energy follows.

Ocean pollution, for the most part due to the transport of oil, is a growing concern. It became an even higher profile issue following the *ExxonValdez* catastrophe. Though there are natural seepages of oil from undersea reservoirs (relatively abundant in southeast Asia), the largest contribution of marine oil pollution occurs due to normal shipping operations and shipping accidents. This may be the case to an even higher degree in Asia, as the east Asian seas are a major transit route for oil carriers. Not surprisingly, data on contamination of oil spilled in the east Asian seas are scarce, and/or uncertain, as these normal shipping "operations" include deballasting, tank cleaning, dry docking, bunkering, cargo loading and cargo unloading. In addition, we must keep accidents in mind, as well as assumptions about uncouth management practises which are not reported. Regarding the latter, it is uncertain how frequently management practises occur which violate the Law of the Sea, in which oil discharge at sea is illegal¹⁶.

Environmental impacts of oil discharges can vary. Oil type, water temperature, quantity of oil spilled, and distance from shore are examples of different factors. The range of their deleterious effects, in terms of national and transnational borders, also varies due to the movement of the spill by

¹⁶Asian Development Bank, Op. cit., p. 87.

ocean currents. The observation of tarball deposition on the coasts of various countries in southeast Asia confirm the need for concern in the area of improved shipping practises, both management-wise and technical (double hulled tankers), as oil tanker traffic will clearly continue to be heavy in the east Asian seas. One example of a fine partial solution to the problem of oil discharges at sea might be to establish some sort of a containment center in Asia for waste oil, in order to manage the waste oil in a responsible manner¹⁷. This will not solve the problem of potential accidents, but it would be a very progressive step in the right direction. One possible location for such a facility would be the vicinity of the Port of Singapore, considering it is one of the busiest ports in the world.

In light of the on-going debate with regards to Asian energy plans which contain a strong emphasis on the future role of coal, other energy options have been discussed. Unfortunately, there are no easy answers, but hydro power could offer some potential sources of energy.

Approximately 30,000 MW of untapped hydropower development potential exist in the major transboundary river basins in Asia in the Mekong River and in the rivers of Nepal which flow into the Ganges in India. The Salween River bordering Thailand and Myanmar is an additional possible source. Though feasibility studies have been done proving the economic potential in developing these sources, it seems the potential for transboundary environmental impacts has hindered the development of additional untapped hydropower sources¹⁸.

Large hydro projects can cause all (or some) of the following: loss of farmland and human settlements, population displacement and resettlement, sedimentation of rivers and reservoirs, soil erosion, and ecological and water quality impacts. In addition, one must consider the transnational effects of developing some of the untapped hydropower sources in regions which share rivers, as the effects are carried over to neighboring countries by the river stream. The types of possible effects are

¹⁷Ibid., p. 104.

¹⁸Ibid., p. 91.

related to some of the following: silt and river bed load; levels of nutrients and aquatic lifeforms; waterborne diseases (i.e. typhoid); and water flow rates and profiles. These effects can result in deteriorating conditions downstream, impacting for example: fisheries; flood plain cultivation; fresh water supply; health; stream bed direction; salt intrusion; ground water; and, wildlife and wildlands.

Though only a mere 16% of the hydro potential has been utilized thus far in Asia, possibilities are constrained by the number of available sites, after all of the necessary considerations have been studied. Hydro project costs must be tailored to many different needs - human and physical geography. Although hydro power is a renewable energy in terms of the resource lifetime, the scale of the capital, socioeconomic, and physical environmental impacts can be astounding. One key solution could be to avoid large projects, and rather focus on small-scale operations which offer the same positive benefits of clean hydro, without as many of the negatives. Though capital costs will still be high, maintenance and operation costs are low and the negative environmental impacts are not nearly as significant¹⁹.

4. GLOBAL ISSUES

Turning now to the most global threat, the anthropogenic emissions of Carbon Dioxide (CO₂): The world's industrialized countries (mostly Western) are responsible for an un-proportionately high percentage of historical GHG emissions; hence these same countries have been called on to fulfill their obligation to: a) stabilize and reduce their own emissions via sustainable energy policies, and b) support the burdened developing world in not following the developed countries down the same ecologically destructive path. The latter is very linked to basic economic development, and has been a contentious issue to put it mildly. In any case, it has been established by scientists that, "the historical growth in emissions has been a direct consequence of the increase of human population, rising incomes, the related exploitation of fossil fuels by industrialized societies and the

¹⁹Ibid., p. 131.

expansion of agriculture.”²⁰ It is important not to lose sight of the global picture of carbon emissions based on fossil fuel utilization. The following table (Table II) is a reminder that developing countries are, per capita speaking, far behind the emission levels of the developed world in CO₂ emissions, as was already illustrated with respect to SO₂.

CARBON (C) EMISSIONS FROM COMBUSTION OF FOSSIL FUELS (1985)

| | Billion tonnes C/yr | Tonnes C per cap.&yr. | Tonnes C per GNP |
|--------------------------|------------------------|--------------------------|---------------------|
| GLOBAL TOTALS | 5.15 | 1.06 | 23.3 |
| North America | 1.34 | 5.08 | 19.7 |
| Western Europe | 0.85 | 2.14 | 18.2 |
| OECD Pacific | 0.31 | 2.14 | 12.3 |
| Centrally Planned Europe | 1.33 | 3.19 | 27.9 |
| Africa | 0.17 | 0.29 | 35.1 |
| Centrally Planned Asia | 0.54 | 0.47 | 82.8 |
| Latin America | 0.22 | 0.55 | 28.6 |
| Middle East | 0.13 | 1.20 | 16.0 |
| South & East Asia | 0.27 | 0.19 | 39.1 |

Table II

SOURCE: IPCC. July, 1990.

Since the causes of climate change are cross-sectoral, response strategies will have to consider a restructuring of all sectors of society. Responding to climate change implies changes in the core of economic activity, such as energy production and consumption, land use and development, and major aspects of technological development. It is basically a matter of internalizing external environmental costs. Though there may be compensations through gains from more efficient resource management, e.g. increased energy efficiency, in the long run there will be a cost. And the costs are likely

²⁰Second World Climate Conference, Op. cit., p. 3.

to increase, as abatement programs commence, if new technologies e.g. in energy production should not be available in the foreseeable future²¹.

Some countries may feel they face difficult trade-offs between economic growth and environmental standards. In the cases of highly populated countries with rapidly increasing populations, it is tough to strike a balance between the need to supply energy in sufficient quantities to allow for economic growth/development while at the same time not jeopardize the environment.

If energy policies are approached more rationally, however, it could result in economic and social development with substantially lower increases in energy consumption. Many problems may be due to a supply oriented approach to energy planning, instead of an "end use" approach which considers the service provided by energy rather than energy in itself²².

Fortunately there is a great deal of un-tapped potential to reduce the current levels of GHGs, in all regions of the world. GHG emissions are a combination of many factors, thus reductions with "no regrets" are possible in many areas. Some of these include: the level and rate of technological development, rate of energy use (and types of fuel used), rates of land conversion and resource depletion (e.g. deforestation), agricultural practises (e.g. wet vs. dry rice farming), and population growth coupled with urbanization²³. Current studies in South Korea, Indonesia, Thailand, China, India, and Bangladesh offer nearly the same proposals to attack future emissions of CO₂. In sometimes varying order (but very similar) these are: 1) Increase energy efficiency, 2) Conserve energy, 3) Pursue fuel switching policies, and 4) Re-forestation. This is, in any case, a simplified list. Other necessary steps would be (to name a few) to create the right incentives to further positive steps forward. Underpricing of fossil fuels and electric energy is a negative and sometimes perverse incentive to low

²¹Hanisch, Ted (1991), *Joint Implementation of Commitments to Curb Climate Change*, CICERO Policy Note 1991:2. p. 2.

²²TERI, Op. cit., p. 32.

²³Ibid., p. 33.

efficiency in energy generation as well as to end use efficiency. This again constitutes economic losses and unnecessary environmental costs. Additionally, it is not always a question of lacking technology to meet the various end uses via more sustainable practises, such as with renewable energy sources. Furthermore, it is not a case of “nobody having thought of it”. Instead, it is the low priority that is often attached to the renewable energy sector and the lack of funds earmarked for the utilization of these energy resources²⁴. There may also, in some cases, be a lack of accessibility to relevant information on renewables, though the most wide-spread barrier to their employment is the disincentive of artificially low fossil fuel prices (subsidization).

Developed countries need to make themselves instrumental, however, if some of the proposals to reduce CO₂ emissions in developing regions are to be realized. Rather than asking whether or not the developing world should be allowed to bear a smaller portion of the costs necessary to curb global climate change, it may be better to pose the question in a light of realism: Can countries burdened with exorbitant foreign exchange debts ever be expected to bear anything but a minimal portion of the total bill, especially considering they have contributed much less to the stock of accumulated (historical) emissions? Realistically, this scenario has to result in assistance, in the form of transfers of capital and technology, from the industrialized world. As a matter of fact, these two types of transfers will end up merging, since one wouldn't be possible without the other.

The process of creating a more sustainable world and saving the global commons is indeed an overwhelming task. However, there are available options within reach, if countries decide to work together.

The work of the Intergovernmental Negotiating Committee on Climate Change (INC) presented a unique opportunity to create the first convention in a new generation of international agreements. The ability of the international community to take on a long-term concerted action to curb climate change would indeed be a major step forward. No previous

²⁴Hanisch, Op. cit., pp. 2-3.

environmental issue addressed entails the same complexity and the number of links to social and economic development²⁵. It is a true case for cooperation.

The convention currently under negotiation by the INC should be an instrument for cooperation well into the next century, which makes it imperative that the convention is built on principles and promotes mechanisms for implementation that will work in the long-term perspective. The climate convention should provide for a gradual process towards global cost-effectiveness, where one would start from least cost approaches and gradually move towards full cost-effectiveness. Response strategies should be worked out in a global perspective, as climate change itself is global, and one must be careful to aim for the best effect of the limited resources to be invested in the global response effort. The first steps could include a majority of investments and policy measures feasible for a number of reasons not related to climate change, often for the sake of efficient resource management only.

There has been agreement in the INC that all countries do have a common but differentiated responsibility to act. In the short run, what is negotiated is a commitment from developed countries to stabilize their current net emissions of GHGs by or around the year 2000. Stabilization of emissions from developing countries will not be on the agenda for a long time to come, otherwise their development needs would be at stake. However, developing countries may have to commit themselves to work out a national strategy on how to keep emissions as low as possible. When developing countries take on unilateral commitments to reduce emissions from a "business as usual" baseline, incremental costs will have to be covered by a "climate fund" provided by the developed countries. This fund, which is likely to be administered by The Global Environment Facility, could be the first element of the financial mechanism of the climate convention.

The second element discussed so far could be a mechanism for joint implementation of commitments. The fundamental point of departure is to

²⁵Ibid., p. 4.

allow for a separation of commitments from their implementation. Since the climate convention will by definition be an arrangement for contracting parties, i.e. nations, commitments to meet abatement targets and strategies will be national. By joint implementation one simply allows parties a flexibility in implementing their commitments.

A mechanism for joint implementation would give the parties of a climate convention the option of achieving, via cooperation, some of the benefits which are described in the literature on a system of tradeable emission permits - without the existence of a real market mechanism being a precondition. In practice it means that parties with high marginal costs for abatement measures would be interested in implementing part of their commitments in cooperation with parties with lower marginal cost. The investing country would get a "credit" for their participation. The latter group of countries, developing countries among them, would have an interest in joint implementation because it will create a source for investment funding otherwise not available. Joint implementation is a mechanism for cooperation on the basis of mutual benefits.

Cooperation through joint implementation could be processed through the financial mechanism of a climate convention according to guidelines and criteria set up by the parties. The contracts will have to be limited in time. If one takes the example of an energy project, e.g. an upgrading of a power plant to achieve a given energy output with less emissions, the natural point of departure would be the lifetime of the investment. This way one could secure that a mechanism for joint implementation could not in any way restrict the long term energy needs of developing countries, but rather allow them to achieve a certain supply of energy at a lower cost, economically and environmentally.

The mechanism for joint implementation will actually move the total global effort to curb climate change in the direction of cost effectiveness. There is a long way to go until this potential is fully exploited, but one would start out with a number of obvious projects that are in fact feasible not only because of their positive effect on greenhouse gas emissions but also for other reasons. A number of such projects are already in the pipeline as part of development strategies. We could also foresee a potential for

regional cooperation on this basis.

In the case of Asia one can easily calculate that the reduction of emissions from coal-based power-stations in developing countries costs much less than extensive measures, say in Japan, where energy systems were modernized by huge investments following the oil shock in the seventies. Does it make sense to insist that Japan's entire contribution in addressing the global problem of climate change should necessarily take place within the borders of Japan? It is hard to say that a comparative calculation would not result in cost differences in this case of factors between 5 and 10.

As mentioned, there would have to be "rules of the game". First off, every project submitted to the Clearing House would be subject to approval by the Clearing House before implementation. With regard to the Clearing House mechanism itself, it is important that this be founded on a multilateral basis in order for the principle of joint implementation to be credible. Scrutinization of each proposed project will be based on criteria and guidelines set up under the convention.

In the work of the INC there seems to be agreement of gradually developing a "comprehensive approach" whereby all parties would be allowed to choose which sources or sinks of GHGs they find most appropriate for response measures. This is also a crucial element with respect to cost-effectiveness. We know that CO₂ is a major source and we know the effect of energy-related emissions of methane. The greenhouse effect of other gases, such as ozone, NO_x, fluorines and chlorofluorines is not yet fully understood. The convention should allow for flexibility in priorities of measures as the scientific knowledge of the importance of different sources and sinks is improved.

5. TOWARDS AN INTEGRATED APPROACH?

In the case of Asia it would be useful to consider how strategies to limit GHG-emissions could be merged with efforts to avoid unacceptable increases in other environmental damage, e.g. the acid rain problem. As we know the two problems have many of the same sources, there should be a

case optimizing the environmental benefit of financial investments. This would have to be based on a study where one models the energy systems of the region and the environmental consequences of these systems. From that basis, it would be possible to formulate a list of priorities. A regional program for interlinked climate change/acid rain policies could then be set up. The funding of such a program will have to be negotiated. In general it is fortunate to know not only that the costs are bearable and distributed on the basis of equity, but also to know that the beneficial effects are optimized. As a matter of fact, much of the data one would need to set up such a program is already available or in process via initiatives from governments, research institutions, the Asian Development Bank and the World Bank.

Secondly, there seems to be a case for regional cooperation for economic reasons and for reasons of long term environmental security. The necessity of modernizing energy systems in many Asian countries, not only for environmental, but also for pure economic reasons is obvious. At the same time, the increasing density of population in the area will more and more underline that the countries are interdependent on long term environmental security. The most developed countries could have the interest and ability to initiate a more integrated effort in the region.

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