"Cleaner Production and Cleaner Energy: Towards Increased Action in the Hemisphere"

For the
First Hemispheric Meeting of Ministers and High Authorities on Science and Technology

Organized by the OAS

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Department of Scientific and Technical Affairs
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ABBREVIATIONS

BOD	Biochemical oxygen demand
CEC	Commission for Environmental Co-operation (North America)
CFC	Chlorofluorocarbons
CP	Cleaner Production
CO2	Carbon di Oxide
EPA	US Environment Protection Agency
HPV	High Production Volume Chemicals
IPCC	Inter Governmental Panel on Climate Change
NO_x	Nitrogen Oxides
NPRI	National Pollutant Release Inventory (Canada)
OAS	Organization of American States
OECD	Organization for Economic Co-operation and Development
P2	Pollution Prevention
PAH	Polycyclical aromatic hydrocarbons
PBT	persistent, bio-accumulative, and toxic
PM_{10}	Particulate matter less than 10 microns in diameter
PRTR	Pollution Release and Toxics Register
SO_2	Sulfur Dioxide
TRI	Toxic Release Inventory (US)
TSP	Total suspended particulates;;
TSS	Total suspended solids.
UNCED	United Nations Conference on the Environment and Development
UNEP	United Nations Environment Program
VOC	Volatile Organic Compounds

THE PURPOSE

This paper forms a part of a group of six papers solicited by the Department of Scientific and Technical Affairs of the Organization of American States to provide background information for the deliberations of the "First Hemispheric Meeting of Ministers and High Authorities on Science and Technology" scheduled to take place in 2002. The delegates at the Meeting, representing the member countries of the OAS are responsible for the policy and implementation of Science and Technology inputs in their own countries and they are the direct links to the respective Heads of Government for the follow-up Summit of the Americas meeting.

This Meeting on Science and Technology, as well as the other Ministerials in the subject areas such as labor, education, trade, environment, forms a part of the New Process of Summits of the Americas. The new process takes the discussions and results of sectoral issues developed at the Ministerials for the approval by the Presidents and Heads of Government at the Summit. These inputs form the basis for the Declarations and the Plan of Action in specific subject areas and on adoption are passed back for follow up action by national and regional institutions. This process of follow up is now tracked by the Office of the Summit at the OAS for greater effectiveness. So, this meeting is an excellent opportunity to discuss, at a high level, the critical issues facing development in the Hemisphere, and to develop coordinated plans of action. (The previous meeting of this kind for Science and Technology was held in Cartagena, Colombia in 1996.)

The purpose of this paper as requested by the OAS is to provide a base for discussions on the very important issue of cleaner technologies. The OAS suggested that the discussions should encompass the use of renewable sources of energy, as well as more efficient use of energy, and, technologies for cleaner production. The paper should allow the Ministers attending the meeting to be aware of the main issues, the current situation for the Hemisphere and the need to adopt appropriate policies and actions. This paper intends to contribute to the development of policies and proposals for hemispheric cooperation by providing: (i) a frame of reference through a succinct description of the main issues, (ii) an examination of major obstacles to the development and applications of clean technologies; and (iii) identification of priority areas for coordinated and cooperative efforts in the hemisphere to promote technological innovations for sustainable development.

The other papers and experts are as follows:

1. Dr. Ahumada, Colombia. Science, Technology and Society, including aspects such as popularization of science and technology, appropriation and dissemination;
2. Dr. Ventura, Jamaica. Science, Technology and Democracy and the use of Science and Technology as tools to fight poverty;
3. Dr. Castelazo, Mexico. Science and Technology to improve competitiveness and efficiency of micro, small and medium-sized enterprises, to confront the challenge of globalization and to prepare for the FTAA in 2005; and
4. Dr. Albornoz, Argentina. Science and Technology in the Hemisphere, including the analysis of current indicators and perspectives for the future.

INTRODUCTION

Several different questions come to mind for the deliberations on this topic at this conference. Among them the first question would be to clarify why cleaner production and cleaner energy are important issues for this august gathering. A related question, given the focus here on Science and Technology, will have to consider how the above issues relate to the S&T systems of the countries. Separately and beyond the issues of national policy raised for governments, we will need to address whether there is a real need and a role for co-operation in science and technology and for cleaner production at the level of hemispheric co-operation. What have been the efforts and achievements in effecting increased co-operation, within the OAS members in general and in science and technology? What have been the challenges and difficulties faced in such co-operation? The answers to these questions can in turn lead us further towards determining specific actions of priority. All of this must be simultaneously placed within the larger context of the role of science and technology in promoting development, its changing and evolving character, and also in the wider national, regional and global context of economic and political changes. This is a very large set of issues and each question deserves more attention than can be provided in one short discussion paper. We have tried to organise this paper to deal briefly with each of these questions and from this we attempt to put forward some suggestions for policy at the national level and also at the hemispheric level. But we recognise that many issues remain to be covered in greater depth and we anticipate that the OAS will follow up with a more in depth look at some of these issues, especially on energy which has many dimensions that cannot be covered here.

ENVIRONMENTAL CONCERNS

There has been increased awareness and concern about the impacts of economic activities on the environment in recent years. It is believed that unless the impacts of economic activities on the environment are reduced the impacts from the environmental constraints on the economy can severely limit the scope for economic development besides affecting many other non-economic variables such as human and eco system health, the scope and extent of new natural disasters and so on (World Commission). The growing concerns relating the environment and human and social development were addressed at substantial depth and at the highest levels of world leaders at the United Nations Conference on the Environment and Development (UNCED) at Rio de Janeiro in 1992. The final report of the UNCED

conference provides a useful starting point on the global consensus on the dimensions of the problem and the principal avenues towards their solution. It recommends a two-pronged approach where priority attention must be given to greater employment and income opportunities for the poor, and also simultaneously, ensure that the rate of use of natural resources and the concomitant degradation of the natural environment must first be slowed and ultimately reversed. The new World Conference on Sustainable Development in Johannesburg this year will refocus world attention on the same issues and examine the progress made, the challenges and difficulties and a renewed commitment to further action. Thus the discussions on these issues in the Americas at this time are most opportune and will reinforce the global commitments and actions.

EMISSIONS AND WASTES

Policy concerns related to emissions and wastes are relatively new in the history of industrialization. There have been earlier occasions where environmental limits to economic growth have been put forward, such as “The Limits to Growth” proposed by the Club of Rome. The principal these was that a shortage of resources would constrain economic growth. (Meadows et al. 1972), While that constrain was found to be weak, the current set of concerns relate more to emissions and waste. In the 1960s, Rachel Carson raised the warning about the potential impacts of chemicals in the environment and it is the growing emissions of wastes from human activities that are of increasing concern. The newer worries place less emphasis on simple models of resource depletion and focus more on the evidence that the ability of sinks to adequately dispose of a growing volume of wastes, from human activities, is under increasing stress (Rath and Herbert Copley, 1992). Further, the increased concern is based on the observations that these stresses are found not only at the local level, but also at national, regional and global levels. Well-known global stresses due to the inability of the environment to deal with the high volumes of waste products from economic activity include the loss of the Ozone layer due to chlorofluorocarbons (CFC) and the potential impacts of global warming due to the waste products of fossil energy use.

Equally worrying is the continued and growing evidence of increased local impacts. An example of ongoing concerns with local impacts is provided by the recent article in the Canadian newspaper The Globe and Mail. Years ago, thousands of Beluga whales were found in the St. Laurence; they are now down to a few hundred and are listed among the endangered species in Canada. Scientists have found that of beluga whales still in the St. Lawrence River 27 percent suffer from cancer, the highest rate

for any wild animal. Dr. Martineau, of the University of Montreal is quoted as saying that the high cancer rates in the whales are linked to the presence of polycyclical aromatic hydrocarbons (PAH), produced by aluminum smelters in the region. The drinking water in the region also has high levels of PAH (For toxicological information on the chemical see www.atsdr.cdc.gov/toxfaq.html). The residents of the region also suffer from high rates of cancer of the digestive system and the workers of the smelters suffer from bladder and lung cancers. (Peretz, Globe and Mail)

It is only natural that these issues of environmental degradation were identified as priorities at the UNCED conference and were also emphasized at the Miami Summit of the Americas (1994). The leaders agreed that guaranteeing sustainable development and conservation of the natural environment were priorities for the hemisphere and agreed to cooperate to promote pollution prevention and sustainable energy use. They also emphasized the important role of science and technology for achieving these objectives and the need for cooperation. The subsequent meetings of the Ministers in March 1996 and the recent Summit of the Americas in 2001 have broadly endorsed these priorities.

ENVIRONMENTAL PERFORMANCE AND THE ECONOMY IN THE REGION

Unfortunately the nature of the waste products and the large numbers of such products makes it almost impossible to provide a full aggregation of all wastes in any country leave alone the entire hemisphere. In spite of the difficulties of aggregation of the environmental impacts of economic and production activities in the region consisting of 34 countries, including the world's largest economy, we have reviewed several sources to provide a quick overview of some of the main problems and issues. Emissions and wastes are often categorized by their release into the air, water or the ground; they can be categorized by their nature, such as chemicals, metals, organic matter and so on, and they can be categorized by their source.

If we start with chemicals and toxic substances, in the US alone, approximately 70,000 or more chemicals are in regular use and hundreds of new chemicals are added each year (Rath and Herbert Copley). High production volume (HPV) chemicals are defined in the US, as chemicals that have annual production and / or use above 1 million pounds each. Two thousand nine hundred and seventy nine chemicals (excluding polymers) are used in quantities above this and so counted as HPV. There are no estimates of the amount of total chemical use in the U.S., but for HPV chemicals, it is estimated that between 4.4 to 7.1 trillion pounds are produced or imported annually (EPA). (The Organization for Economic Co-operation and

Development (OECD) maintains a list of chemicals which have annual production volumes greater than 1 thousand metric tonnes (2.2 million pounds in member countries and they list 4,102 HPV chemicals in OECD countries. (http://www.scorecard.org/chemical-profiles/def/hpv.html)

An EPA study found that very little basic toxicity information is publicly available on most of the high production volume (HPV) chemicals in use leading to a new "Chemical Right-to-Know" Initiative in the US in 1998. Without basic hazard information, it is hard to make sound judgments about the potential risks these chemicals present to people and the environment. The initiative is an ambitious effort to tackle the lack of information by rapidly testing chemicals in co-operation with firms and making this important data available to scientists, policy makers, industry, and the public. To implement this initiative the EPA Administrator has invited chemical manufacturers and importers to participate in a voluntary challenge program to provide the basic toxicity data on the HPV chemicals they use. EPA is also pursuing additional reporting of information on those chemicals that are persistent, bio-accumulative, and toxic (PBT); chemicals of particular concern to children's health will be the subject of more detailed and extensive testing. Under a similar international Initiative, global chemical manufacturers and importers have volunteered to complete hazard assessments on 1,000 HPV chemicals by the end of the year 2004. The magnitude of the problem can be seen from the fact that 500 organic chemicals were newly reported as HPV and are not yet included within the HPV Challenge Program.

The US does have an excellent public information system called Toxic Release Inventory (TRI), which is a mandatory system of data reporting by all users of 606 defined substances. The TRI list was started in 1986 with a list of 300 chemicals, and is possibly the first such reporting system in the world. It has evolved over time with the addition of new substances and with lower thresholds for reporting on chemicals that are persistent, bio accumulative, and toxic.

Unfortunately we do not have as comprehensive data from other countries in the region as is available for Canada and the USA. Mexico has started a *Registro de Emisiones y Transferencia de Contaminantes (RETC)* for 11 sectors under federal jurisdiction covering 104 chemicals from 1997. This is a useful first step, but it remains a voluntary program and its coverage of waste streams is much narrower. Looking at other recent studies for the region, to assess the priority for wastes, we see in the World Bank study of Argentina, Chile and Mexico (Dasgupta et. Al. 1998) that water pollution due to direct discharge of domestic and industrial wastewater into water streams is a very large problem. The study states that in "Mexico and Chile in

particular, the severity of the problem has led to a high level of health-related risks and waterborne diseases." Major industrial contributors to water pollution in these countries include slaughterhouses, meat processing, tanning and leather, metal finishing, light chemicals and dairy products. Inadequate treatment of domestic and industrial wastes that are discharged into water courses; high metal levels detected in mining and industrial zones; and, extremely high fecal coliform counts in irrigation waters from untreated sewage contamination are major problems in the region. Overexploitation of limited water resources; waste water pollution from oil, paper, foundries, textile, mining, coffee processing, sugar and leather sectors as well as untreated domestic and municipal sewage, leading to waterborne diseases are some of the major problems for the region.

Air pollution, from transport and industrial activities is the second priority issue after water pollution, according to the study. Lead pollution in the three countries, and in all other countries of the region, according to ECLAC, caused by the use of leaded gasoline is a major health hazard. High levels of suspended particles, lead, SO_2, CO and NO_x in urban areas and air pollution from industrial plants in the mining, petrochemical, cement, power plants, oil refineries, cement, pulp & paper, organic/inorganic chemical manufacturers, glass and foundries.and metals refining sectors are the major problem areas.

With the absence of any treatment facilities for handling industrial toxic wastes, the majority of the waste is usually dumped into unregulated landfills and/or waterways furthering the pressure on water quality. In Chile, it has been explicitly reported that toxic and hazardous waste have not been extensively inventoried and that the disposal destination of these pollutants is unknown. (Sources: World Bank data for the region and ECLAC)

At a broad macro level, there is a study by Hettige and others, who use the US TRI data and the country level economic sector data to estimate the changes in emissions and wastes. They find an upward long-term trend in industrial emissions, in total volumes, and relative to both GDP and to manufacturing output, for the majority of countries of the hemisphere. These long-term trends for industrial emissions are higher for the lower-income countries because of the displacement effect of industrial activities as environmental regulations are tightened in the richer countries.

EMISSIONS FROM ENERGY PRODUCTION AND USE

Energy production and use often contribute the largest share of emissions and waste

that are harmful to the environment, to human health and to the economy. Energy remains one of the critical inputs to economic activities and to growth, yet there is little value in producing and using energy inefficiently as energy is never the primary product that is desired (except for energy producers); however, it is the output and work that energy availability makes possible that is the desired end product. To the extent that efficient means of energy use can reduce the need for increased energy production, it is beneficial to the economy and not harmful. To the extent that the required energy can be produced with cleaner energy resources we can reduce many of the negative impacts from energy production and use.

Energy production, particularly from the use of fossil fuels, and the use in transport, by utilities, and industry, contributes to the emissions of Lead, Volatile Organic Compounds (VOCs), Sulphur Dioxide (SO_2), Nitrogen Oxides (NOx), Mercury, suspended particles and always Carbon Monoxide (CO). Each one of these is a serious environmental hazard for the hemisphere. SO_2 contributes to acid rain, which damages forests, lakes, wild life and human health. In spite of major efforts to control acid rain in North America much remains to be done. Mercury is released in coal mining and coal burning and is extremely toxic and is spread widely through the coal burning plants. The recent report from the CEC analyzing North American emissions states that electric utilities burning coal and oil rank first among all production sectors in the region**.** They contributed to a total release of 436 million kg., or 27 percent, of the wastes reported in Canada and the USA (taking into account only the 165 chemicals common to both Canada and USA from the national registry of each country).

If we focus on the contribution of energy production and use to air pollution, the critical role of energy from fossil fuels in contributing to pollution are even more dramatic. US EPA has listed CO, NOx, VOC, SO_2, lead and PM10 as “criteria” air pollutants (that means for each one the EPA must publish a criteria document, which compiles the known information on the harmful effects of the specified pollutant). Fossil fuel combustion in power plants, vehicles and industry, contribute to 83% of CO emissions, 95% of national NOx emissions; 43% of VOC, 94% of SOx, 80% of PM10, and 23% of lead emissions (EPA, 2000). Of course as we could expect, energy use from fossil fuel combustion contributes 83% of the total US Greenhouse Gas emissions. Within the energy sector, the contribution of power generation is 36%, of transport is 30%, all industrial uses are responsible for 23%, while households and commercial uses are responsible for 7 and 4 percent respectively of greenhouse gas emissions.

We give one Canadian example of the impact of coal burning for electricity production from the province of Ontario reported by the David Suzuki Foundation. There are five power plants in Ontario that burn coal to produce electricity and they supply one quarter of the total electricity generated in the province. These five plants produce 23% of the SO_2, 14% of NOx, 23% of the mercury emissions and 19% of the CO emissions in the province. The Foundation estimates that the entire amount of energy produced from these plants can be replaced by cleaner sources, with half from renewables and the other half from efficiency improvements, at attractive economic rates.

Among energy related emissions, lead poisoning is considered the number-one environmental health threat to children in the U.S. even after it has been removed from gasoline used by cars and new emissions have dropped by dramatic amounts. It is not surprising that with the continued use of leaded gasoline for automobiles in Latin America, the World Bank (Dasgupta et. Al. 1998) found that lead pollution in Argentina, Chile and Mexico was very high, and, according to ECLAC, all countries of the Latin American region, suffer from levels of lead sufficiently high to be a major health hazard; this is a potentially avoidable pollutant (there are a few cities and regions, such as Sao Paulo, where leaded gasoline has been banned for a number of years).

To make sense of these many pollution-related issues the US EPA's Science Advisory Board undertook an exercise to categorize them into priorities. The highest risk category problems identified by the Science Board included the problems of global climate change and, ozone depletion, habitat destruction and loss of biological diversity. It is important to note that energy consumption and use is the greatest driver of climate change and is one of the largest contributors to other high-risk problems. If one follows the medium and lower risk problems, in each case the production and use of energy is one of the largest single contributors to the problem. It will require a separate paper to fully discuss all the energy related issues.

PROGRESS TOWARDS A CLEANER ENVIRONMENT

Historically our perceptions of the problems of pollution and waste and the sequence of responses to the problems have moved through a long cycle. The initial response at the earliest stages of industrialization everywhere was to ignore the problem of emissions of wastes. This approach remains prevalent in regions with low industrialization and poor employment opportunities, where even today, concerns about pollution are seen as an unaffordable luxury. Even today there are people who see the signs of smoke stacks and grid locked highways as positive evidence of development and wealth. There are also individuals who believe that what is not seen is not important. An example of extreme shortsightedness that we have encountered is at a five star resort in the hemisphere, which discharged the sewage generated by the hotel guests into the ocean near the hotel. While this solution was cheap, and "worked" for some time, it had to be abandoned when there was a large outbreak of sickness among the residents and it was traced to the human wastes and pollution in the nearby ocean waters. The positive feature of this example is that, except for the fact that the guests also suffered (fortunately not seriously), the negative consequences of the polluting action impacted directly on the economic agent responsible for the pollution. But even here, the negative consequences did spill over to the guests, and to other nearby resorts whose reputation was negatively impacted even though they did not contribute to the problem.

Not caring for the wastes can work, when the quantity of wastes are small compared to the sink where they are disposed of and provided the waste can be biologically degraded within a reasonable time period. This situation remains true today only for very small remote communities who are also not large consumers of nonbiodegradable or toxic products. However, as chemicals and industrial products have become more complex, less biodegradable, larger in volume and the wastes more dangerous and persistent, the old strategy of "out of sight-out of mind," stopped working well. The spectacular impacts of hazardous wastes at several sites in the US led to a range of legislation to monitor, control and clean up, where required, many toxic substances. (See www.epa.gov/superfund/action/20years).

An approach related to the "out of sight-out of mind," method of dealing with wastes includes efforts to dilute and disperse the pollutants. This again can work when the substances are low in toxicity and relatively small in volume. When that also proved inadequate, the approach used was to control the 'end of pipe' emissions. Until the

early eighties, when the first applications of the pollution prevention (P2) approaches were tried, the easier and simpler, not necessarily cheaper or more effective, technological solution was to control emissions after the fact with add-on devices or to disperse the waste with higher smoke stacks and other means. Finally, and fairly recently, we have seen the increasing emergence of the P2 and "clean production" paradigm because ultimately the newly identified environmental concern are not amenable to "end of pipe" solutions or to better dispersal or disposal methods.

Problems of global warming, ozone depletion, soil depletion, toxic contamination of soils and water resources, loss of habitat and biological diversity all require a change of production techniques, a reduction in materials and energy throughputs, more efficient production, changes in the final products and also in the consumption ethic. All of these concepts are embedded in the newer approach of cleaner production, pollution prevention and industrial ecology.

Cleaner production technologies provide a more fundamental and basic approach to dealing with environmental degradation from economic activities. The concept is applicable and relevant to manufacturing, agriculture, hospitals and hotels or all economic activities. Clean technologies also provide developing countries with the additional possibilities of "leap-frogging" over the older, more polluting, growth path followed historically by the more industrialized countries.

Cleaner production and technologies provide a solution where the needs of richer and poorer countries are in greater congruence. It provides the former with the means of tackling their currently high level of waste production and it provides the latter with an approach to solve the problems of poverty and achieve economic growth, without degrading their natural resources.

CLEANER PRODUCTION/POLLUTION PREVENTION

The terms Cleaner Production, and Pollution Prevention (P2) are often used interchangeably. The distinction between the two tends to be geographic. The term Pollution Prevention tends to be used in North America, while Cleaner Production is coined by UNEP and more commonly used in other parts of the world. There is a wealth of information on Cleaner Production and Pollution Prevention on the web (see Annex). Only brief introductions to the relevant issues are given below, and these rely on existing material. Links are given for a large number of sites for practitioners who wish to work on these issues in depth.

Cleaner Production (CP) and Pollution Prevention (P2) focus on a strategy of

continuously reducing pollution and environmental impact through source reduction that is eliminating waste within the process rather than at the end-of-pipe. Waste treatment, after the fact, does not fall under the definition of CP or P2 because it does not prevent the creation of waste in the first place.

The US Environment Protection Agency (EPA) defines Pollution Prevention (P2) most strictly, as the "source reduction-- preventing or reducing waste where it originates, at the source -- including practices that conserve natural resources by reducing or eliminating pollutants through increased efficiency in the use of raw materials, energy, water and land." Under the Pollution Prevention Act of 1990, pollution prevention is the national environmental policy of the United States.(http://www.epa.gov/opptintr/p2home/) This definition focuses on source reductions and does not consider reuse or recycling within the ambit of P2.

Environment Canada defines Pollution Prevention as "the use of processes, practices, materials, products or energy that avoid or minimize the creation of pollutants and waste, and reduce the overall risk to human health or the environment." (http://www.ec.gc.ca/p2info/english.htm). The Canadian definition is a little less strict than that of the US and allows for on-site recycling and recovery processes.

UNEP defines Cleaner Production as "the continuous application of an integrated preventive environmental strategy applied to processes, products and services to increase overall efficiency and reduce risks to humans and the environment." (http://www.uneptie.org/pc/cp/understanding_cp/home.htm) The UNEP definition is focused more on the dynamics of the technological process and on continued improvements over time, and it allows for recycling and reuse, by focusing on the overall efficiency.

The possible differences become clearer if we look at the activities defined as P2 by the USA and by Canada. Seven activities are defined as P2 in the Canadian NIPR data registry.

1. Raw material or feed stock substitution especially of toxic materials
2. Redesign and/or reformulation of product
3. Process, equipment and plant modifications
4. Minimize leakages and spills

5. Improved operations and good housekeeping

6. Improved environmental management systems and materials controls

7. On site recapture, reuse and recycle

The US TRI provides definitions for the first six activities above in a larger number of categories, and the final activity is not accepted as a "source reduction" activity. Yet, that does not mean that there is a real disagreement on what constitutes cleaner production. As the US EPA notes, while recycling and recovery are not included within the legal definition of the P2 Act, in-process recycling and any other recycling that is undertaken in an environmentally-sound manner share the advantages of pollution prevention. The data reported by companies in the US and Canada that are undertaking P2 processes suggest that activities 1 through 4 are dominant (CEC).

BENEFITS OF CLEANER PRODUCTION:

- Reduce production costs through greater efficiency
- Decrease waste of material inputs
- Increase productivity and often improve products
- Reduce energy consumption
- Recover valuable by-products
- Minimize waste disposal problems, including charges for waste treatment

ENVIRONMENTAL TECHNOLOGIES

Note that environmental technologies are a much broader group than P2 or Cleaner Technologies, as environment technologies include:

- *End of pipe technologies, which* are added to a plant to treat pollution, often hold, dilute, disperse and also treat to make it less hazardous, after the waste stream has been created;
- *Recycling technologies*, which take the waste product and then reuse it, as with aluminium cans, glass bottles, paper and some plastics.
- *Remedial technologies* are aimed at cleaning up or reclaiming currently damaged environmental resources, such as land and water;

- C*lean, or more appropriately, cleaner technologies* that are designed to reduce the amount of energy and raw materials needed to produce, market and use products, and services.

We have mentioned earlier that there is a gray area or possible overlap between cleaner technologies and recycling technologies. In fact the IPCC and UNEP have defined a category called ESTs or Environmentally Sustainable Technologies as technologies that "protect the environment, are less polluting, use all resources in a sustainable manner, recycle more of their waste products, handle residual wastes in a more acceptable manner than technologies for which they are substitutes, and are compatible with nationally determined socio-economic, cultural and environmental priorities". This is clearly the broadest group of relevant technologies, and is clearly comparative to existing options and also to national conditions.

The key point to establish here is that there are several definitions and types of technologies. From among these, end of pipe, recycling and remedial technologies have been the more traditional approaches; these are relatively well defined and measured with greater statistical accuracy. P2 and CP provide approaches and methods, to review production processes, resulting in new technologies that are less well defined and less easily measured. In terms of subsets, all P2 technologies will be counted as CP methods, all CP will be ESTs, and all ESTs fall under the largest category of environmental technologies.

Finally we must caution some care in the use of a relatively new category called "The Zero Emissions" concept. As defined by the UN University, it envisages "all industrial inputs being used in final products or converted into value-added inputs for other industries or processes. In this way, industries are reorganized into clusters such that each industry's wastes / by-products are fully matched with the input requirements of another industry, and the integrated whole produces no waste of any kind (http://www.unu.edu/zef/concept.html)". We believe this is theoretically impossible and would violate the basic law of thermodynamics. Softer versions of this collapse into the cleaner production definitions that we have provided. Another use of this is prevalent in the transport sector where vehicles using fuel cells or electricity are termed Zero Emission Vehicles. But here the sleight of hand involves looking at only one part of the energy chain and not considering the life cycle of the emissions involving the fuels if they are based on fossil fuels.

CLEAN TECHNOLOGIES

Those labeled clean technologies focus on minimizing the release of a potentially harmful contamination to the environment in the first place by preventing pollution and reducing wastes at the source instead of subsequently dealing with the pollution generated. They may include process technologies that introduce major changes to the core technology to achieve environmental benefits, product technologies that modify or introduce new designs, and new specifications of final or intermediate products, to reduce materials and energy use and replace hazardous materials with less hazardous ones.

The labels "Clean", "Green" or "Environmentally Sound Technologies" (EST) are those, which modify or improve products and production processes at the source to minimize the waste stream and the environmental impacts. These terms are often used interchangeably and there is no attempt to distinguish between them here. Generally, a technology can be considered clean and environmentally sound if it:

- Increases efficiency in the use of raw materials and energy,
- Eliminates or reduces emissions of harmful wastes generated in production and ensures minimum hazards to human and ecological health; and,
- Promotes the reuse and recycling of inputs and final products.

ELEMENTS OF THE CLEANER PRODUCTION METHODOLOGY

Cleaner production is a combination of several different approaches and is a multi-step and iterative process (UNEP, USEPA). It starts with the acceptance of a new vision at the national and organizational levels that the best way forward is through the adoption of "cleaner production" and pollution prevention. At the national level, it requires the identification of major problem areas and sectors for priority action. With management commitment, resources are assembled to audit and assess production processes. The team designs flow diagrams of the entire operations, and, records all material and energy inputs, process outputs and by products at each stage of operations. These material flow and balance data are used to derive an initial list of cleaner production options.

These normally include:

- Identification of obvious and short-term waste reduction, good housekeeping

recycling and reuse options, characterization of problem wastes and development of medium and longer term options to improve process efficiency, modify products and processes to reduce wastes and increase efficiency including R&D as required,

- Technical, economic and environmental analysis of cleaner options.
- Implementation of selected options.
- Monitoring and evaluation of results and restarting the analysis of production, processes.

Process integration, where the entire production stages are re-examined, and several discrete stages are combined together, while some are eliminated altogether, has proven to be one successful approach to reducing material and energy conservation. They can also sometimes result in capital and work in process savings as well.

The cleaner production philosophy is embedded within a new paradigm of production systems approach called Industrial Ecology. This new paradigm is modeled on ecological principles and emphasizes the need to understand the flow of energy and materials through industrial systems, their effect on the environment, and the inter-relationships between technologies, regulations, fiscal policies and operational practices on these flows. Industrial ecological approaches incorporate the analysis of entire process flows, recycling of waste, life cycle of products, all from the initial product and process design stage, to its final disposal, keeping as an objective the minimization of environmental impact.

EXAMPLES OF CLEANER PRODUCTION

There are many, and rapidly growing numbers of examples which are now available where cleaner production approaches produce 'win-win' situations for the firms, the economy and the environment. We have earlier listed some of the following examples (Rath, 1995). One machine tool factory spent $350,000 in redesigned processes to meet environmental standards and recouped $900,000, Monsanto, a chemical Company, has been able to save hundreds of millions of dollars annually and reduce its discharges of pollutants by an order of magnitude through the use of these principles. UNEP provides dozens of case studies and examples of cleaner production across different sectors from many countries, illustrating that the principles and approaches are applicable in all sectors in all countries. It will be useful to cite a few cases from the set to illustrate the general principles and their applications.

An Austrian printed circuit board manufacturer saved over $1 million, (2% of total revenues), and, over 50% of acids used by the application of process analysis and

good housekeeping. In Chile, a textile dying plant used new monitoring and recycling technology for distillation, fermentation and energy conservation for savings of over one million dollars per year, In Denmark, a cotton bleaching plant replaced reducing agents with an enzyme based process for a cost saving of $15-30 per ton of fabric. In France, an equipment maker replaced chemical cleaning by thermal scouring. In India, a small paper producer introduced a series of process modifications and new technology to get high quality, reduced pollution and attained cost savings of $120,000 per year. Another small enterprise producer is able to save $35,000 per year with an improved furnace design. In Holland, product design reduced costs by 50%. A group of projects in the Philippines indicated a savings of 10% in costs and 50% in reduced emissions. For many more examples see the sites and information sources listed in Annex 2.

Moving from the firm level to a sectoral level, a noteworthy achievement reported from Costa Rica shows how the wastes from coffee production have been brought down with the application of these principles (UNDP (2001). Approaches to Sustainability, Costa Rica: National Commitment to Sustainable Development, United Nations Development Program, Capacity 21, Costa Rica.) In Costa Rica as in a number of Latin American countries coffee is an important economic sector and also contributes to large pollution loads on the water resources. The case reported here shows how the use of water was reduced by 75% and the total BOD load on the discharge water was reduced by large amounts. There are a number of other efforts reported in Latin America, specially targeted at small and medium enterprises (SMEs), which have also reported similar promising results. The PROPEL project in Colombia assisted 300 SMEs in Bogotá engaged in leather taming. Through the adoption of recommended measures, the project reports that there has been a 50% reduction in discharge of suspended solids, a 30% decrease in water consumption, an increase in profitability of $2.00 per hide, resulting in a pay back of 1.5 months for the costs incurred by the firm. A similar effort by INSOTED, Ecuador, reports positive results for 120 SMEs in the chemical, food, and tannery sectors. Initiatives by Camara di Industrias de Costa Rica and by SENAI in Brazil have been reported without details on the coverage and impact. *It will clearly be an important initiative by the OAS to review and document such national efforts in the hemisphere and promote the sharing of experience and learning.*

One important conclusion that emerges from an analysis of these case studies is that the scope for energy savings is very large. Very often the positive financial returns from the applications of cleaner technologies result from the savings in energy. (Of

course, this is partly due to the fact the cost of water used and the levels of pollution charges are often lower than should be, while ienergy inputs are usually charged at market rates.) When we focus on financially attractive energy efficiency options, the numbers of cases available are much larger given the longer period of time that energy efficiency has been an important priority. Examples of large savings with high financial returns are provided in Adelaar and Rath for the Caribbean hotel sector, by Maldonado for Chile in the mining and hospital sectors, and a summary of experiences is provided by Rath (http://www.pri.on.ca/EEconf.HTM). That this is a robust finding is confirmed by the recent announcement of the US EPA Administrator, Christie Whitman of the results from the energy star program for buildings (EPA, 2002). The energy star is a labeling program provided to products that achieve significant reductions in energy consumption. In this case for the 729 buildings, the energy consumption is lower than the average for the US by 40%, the annual operational costs (for energy for offices) are $1.23 per square foot compared to $2.09 for the average building. These savings were achieved with a return on investments that often ranged above 50% and reaching over 100% of capital invested (private communication from Tom Hicks, US EPA, 24 April 2002). The Canadian Green Building Challenge also provides a number of examples of savings from innovative designs that are 30-50% higher than the energy consumption that would have prevailed had the new and improved codes been followed.

The general conclusion from all these cases is that the applications of cleaner production technologies start first with the conviction by the user that improved performance is possible. Only with user co-operation can one begin to add the professional inputs, undertake the simple audit procedures, and move on to improved housekeeping, and from there to the modifications of products and processes and applications of new scientific and technological principles. Further, these principles are broadly applicable in sectors ranging from agriculture, to hotels and buildings, in large and small industries. In a large number of cases such application leads to immediate reductions in pollution levels of 50-100%, to reduced use of energy, water and other material and at the same time increased economic gains with pay backs of a few months to a few years for the investments made. While some suggest that these examples are only the “low hanging fruit” and efforts must go well beyond reaping the easy and quick benefits of picking the “low hanging fruit” we believe that there is an immense amount of “low hanging fruit” that can provide for benefits of pollution reduction, economic and health benefits, and provide the base for deeper actions in the future.

SCIENCE AND TECHNOLOGY INPUTS FOR CLEAN TECHNOLOGY

It is important to clarify at this point that clean technologies also involve and require major scientific and technological inputs beyond the initial step of process audits and good housekeeping. Some of the technological changes involve improving designs of processes and products, and, taking advantage of newer knowledge and best practice. Others rely on entirely new inputs from the latest advances in biotechnology, monitoring, information and control technologies, new energy sources and advanced materials. *Incorporation of the latest scientific knowledge in the development of clean technologies requires changes in the way R&D priorities are set and the organization of coordinated research on environmentally critical technologies and the establishment of research and industry consortia and networks.*

Enzyme technology, a new area of research and applications for example, can gradually replace many chemical industrial processes. Enzymes work best at mild temperatures and in mild conditions. They can be used to replace harsh conditions and harsh chemicals, thus saving energy and preventing pollution. They are also highly specific, which means fewer unwanted side effects and by-products in the production process. Enzymes can also be used to treat waste consisting of biological material and they are biodegradable.

In starch processing, for example, enzymes have largely replaced the use of strong acids and high temperatures once used to break down starch. Enzymes could have a major impact on several other branches of industry. For example, in the extraction of vegetable oil from oil seeds, a new enzymatic process under development is intended to replace the current technology using hexane which is highly explosive and poisonous.

In tanneries enzymes can replace harsh chemicals used to remove wastes from animal hides, and, can also treat tannery waste. Similarly, in the pulp and paper industry the use of enzymes in pulp bleaching can boost the effect of bleaching chemicals and reduce the amounts of chlorine or its compounds. In the future enzymes may be able to replace bleaching chemicals completely in detergents, and many of the ingredients can be replaced while still maintaining the same performance by adding enzymes which are 100% biodegradable.

These are a only a few examples where the development of clean technologies must go beyond simple housekeeping into basic fundamental research. Other new technology areas of broad applications would include renewable energy sources, fuel

cells, biomass combustion and use in non-energy applications, information technologies, advanced materials and many others. For instance scientists at the University of California, Berkeley, have announced a new generation of plastic solar cells that can some day replace the currently developed bulky and expensive silicon based solar cells (Science, March 29, 2002).

The choices for research and action focus will vary by sector and place, and will depend on needs, resources available, and available technological capabilities. Also, the environmental soundness of technology is a dynamic and relative concept. A technology deemed "clean' today will lose this status when a better alternative is found in the future, or a good alternative in one area may not be appropriate for another sector or region. Moreover, a technology considered benign may be seen to be damaging once all of its consequences are known. And for a given environmental problem, a plethora of cleaner technologies is possible, so it is difficult to make a master list of "clean technologies" which should be supported. 'Soft' technologies such as management practices and know-how are as important as such "hard" technologies as tools, machinery, and equipment.

SCIENCE, TECHNOLOGY AND THE ENVIRONMENT

Almost everyone today is aware of the increasing evidence regarding the importance and contributions of science and technology, or knowledge and innovations, for development. Many in the audience have been involved in this sphere as researchers, scientists, administrators or policymakers and so are knowledgeable about some of the emerging trends and challenges from science and technology, which confront the world. At the beginning of the twenty first century, it is almost a cliché to state that science and technology have become the most important drivers of economic change, and they confront all countries with new opportunities and challenges. It would thus be highly unusual if science and technology did not have a signal role to play in improving the environment.

In fact, the discussions and contributions to the process leading up to the UNCED conference at Rio, and the final conclusions, have established certain key propositions regarding the issues of technology and the environment, which are now widely accepted. (It is useful to note here that in the global discussions on the environment, there have been some major differences between the more industrialized countries and the developing countries, and both groups are

represented in the hemisphere. Issues related to technology have often resulted in some of the widest disagreements. We will not enter that debate here but argue that a large number of technology related issues also provide some of the best opportunities for mutually beneficial cooperation).

It is generally agreed that the following stylized facts apply to the prevailing circumstances:

- In the absence of technical change, environmental degradation will increase to unacceptable levels.
- Degradation of the resources will force productivity decreases and other damages.
- If developing countries adopt the obsolete, resource intensive techniques used in the past by the currently industrialized countries the levels of environmental damage will be higher than necessary.
- It is important, where possible, that less industrialized countries skip past the earlier waste intensive development phase to the extent possible and "leap frog" to the most economic and environmentally efficient modern technologies available.
- Most technological development occurs and will continue to occur in the more industrialized countries; therefore, technology cooperation is a necessary condition for sustainable development.
- Effective technological solutions require increased and redirected technological efforts and capabilities in all countries.
- Technological change will need to be complemented with economic, political and social change.
- The private sector will be the main developer and user of most technologies.
- Governments need to set the environmental goals, the regulatory and policy framework that supports rapid innovation and their adoption.
- These government actions will play a critical role in the speed and depth of development of EST and their diffusion by the private sector (Barnett).

As the Brazilian expert Trinidade states “the state of the environment today is the result of technological choices of yesterday. Similarly, the state of the environment in the twenty first century will depend on the technologies we choose today” (UNEP, 2001). To explore further how technology can contribute to cleaner production we

must quickly define the key elements of the S&T system that are relevant to this discussion.

In these discussions, technology is defined as the mix of knowledge, organizations, procedures, machinery, equipment, and human skills that are combined to produce socially desired products. Changes in most components are generally required to make changes in a desired product, process or service. Innovations are introduced either by completely new technologies or through a process of incremental technical change. The latter is often neglected in discussions of Science and Technology because it requires local resources at the firm and sectoral levels, which are not easily purchased from outside but have to be internally developed. The adoption of new technology is a complex process, and it always requires successful adaptations to local conditions, continued improvements over time, and the capabilities to generate further technological change in the future (Rath and Herbert Copley; and Barnett).

'Science' is only one component of codified and organized knowledge and such knowledge has existed in all societies at all times, as have technologies. What is new, and of growing importance, is the systematic pursuit of scientific knowledge and its rapid application to social and economic purposes, which has led to an accelerated rate of innovation, all of which provide countries with previously unimagined opportunities and challenges.

We have argued earlier that too often science and technology are defined much too narrowly. Ultimately, we are interested in the increased availability of knowledge to all individuals, institutions and societies and in the greater and more effective application of knowledge to economic and social activities. Knowledge both grows out from and contributes to the daily productive activities of people (Rath and Herbert-Copley 1993).

Of course, there is a subset of knowledge activities, which grow out of more systematic efforts at generation, codification, and transfer of knowledge, normally undertaken in educational and R&D institutions. Often it is only the latter type of institutions, and their work, which are counted as legitimate activities of science and technology. But there has been much useful and practical knowledge generated from practice and this is much larger than the body of knowledge formally declared as science. It includes the knowledge gained from more modern social innovations, such as large scale monitoring of emissions, public information programs; extension

programs to improve industrial or agricultural productivity; and the design of incentives and penalties, often called “soft” technologies.

We must also repeat here the fact that science is necessary but not sufficient for technology, and similarly R&D efforts are necessary but not sufficient for innovation (Anandakrishnan 1998). Even in the developing countries which have emphasized the supply side of the science and technology equation, such as building up educational and research facilities and increasing the supplies of trained manpower and resources for technology development, the weakness of the demand for the outputs of S&T systems from the users of knowledge has often resulted in poor utilisation.

Innovation requires linkages between the producers of knowledge and the users and is no longer seen as a linear process where inputs to science lead to technology development and the new technologies are in turn embedded in the production process as innovations. Rather, it is seen as a more complex, interactive system, which is defined as the National System of Innovation (NSI). Research into the performance of the NSI in promoting desirable technical change demonstrates that a number of traditional inputs of the S&T systems, such as increased expenditures, capacity, and research are all required and are necessary but not by themselves sufficient to promote innovations.

STIMULATING TECHNOLOGY APPLICATIONS AND REMOVING BARRIERS

Access, demand and financing for clean technology, and the requisite policy framework, technological capability, infrastructure and relevant institutions for disseminating and utilizing the technologies are all areas for action to different degrees in all countries. For effecting faster rates of desirable technical change in the hemispheric countries attention must be devoted to three, often overlapping, issues:

- the development of new technologies and practices relevant to local production conditions;
- the application of existing more efficient, cleaner technologies, on a wider scale, and
- efforts to improve the efficiency with which both old and newer technologies are operated.

Effective policies must integrate measures to stimulate the supply of cleaner technologies and others, which will increase the demand, for their application in the

user sectors and firms.

SUPPLY

The supply side issues of building capacity, education, training, and the creation of specialized institutions are all well known to policy makers in S&T. These include the direct means of support of technological development, such as research, development and demonstration (RD&D), definition of new research priorities, technological networks and so on. Newer supply side issues include improved and targeted information supplies and knowledge exchanges, networking, and other outreach and dissemination programs made possible using new information and communication technologies (ICTs).

There is a need for increased scientific and technical skills and increased research capacity in many of the countries of the region in order to generate new knowledge and technologies. There is also a need for R&D work in a number of areas in order to develop solutions to unique problems and for priority setting exercises to redirect scientific effort in the required directions. Technology strategies must also contend with the increasing "science-based" nature of technological change in many fields requiring increased collaborative efforts both within and among countries.

We expect that the papers by Dr. Albornoz and by Dr. Castelazo will address the more specific issues of resources for S&T and their linkages with firms, especially for the smaller sized firms. We will only add here that countries that are spending less than 1% of GDP on S&T inputs are simply putting too little effort and must find ways to increase their participation. Any successful co-operation between countries requires that individual partner countries must have some minimum domestic capacity and must undertake some minimum national activities in science and technology. Also they must take the first steps towards creating the required institutions for monitoring and managing the wastes within their own countries.

The OAS data base on individual countries inputs in developing national capacity in Science and Technology shows a very wide variance. We have the US which spends the largest percentage of GDP towards S&T and with the largest GDP, its spending is larger than all the countries in the hemisphere together.

Beyond the scale of inputs, as regards the structure of the national innovation system and its management, the reviews by the IDB of national S&T programs for Brazil, Chile, Costa Rica, and Uruguay, (see also the summary report by IDB, and the review by Mullin of Chile), provide a number of details for national policy makers, that are

worthy of follow up to enable a more dynamic S&T environment.

However, especially for cleaner technologies, all such supply-side options must be combined with measures to increase the demand for new technologies in the hemispheric countries and these must be based on our new understanding of barriers to innovations in general and specific barriers to environmental technologies, which prevent their wider adoption through various sectors of the economy. The utilization of scientific and technological knowledge is facilitated by linkages between producers and users of knowledge. Such links are often weak or non-existent within many of the countries of the region and ways must be found through new technology co-operation programs to create linkages with enterprises.

DEMAND

The demand for new and improved technologies can in general be improved by a number of strategies: the removal of barriers to their deployment, setting standards that require newer and cleaner technologies, by modifying and expanding markets, removing legal and institutional structures that reduce the demand for innovations, eliminating distortions in prices and specially of input subsidies that allow inefficient practices to continue and make the adoption of cleaner technologies less rewarding, making investment and regulatory regimes more stable and transparent to attract greater financial resources, and by providing various market-based incentives at various stages of development and/or use of new technologies. With respect to cleaner production technologies, while in the longer term supply of newer technologies will be important, in the shorter term the problems of lack of demand and the lack of adequate information are among the key barriers to their utilization. So we take up these two issues for greater discussions.

FINANCE

Financial constraints are always important and there is never enough whether one discusses S&T inputs, information programs, co-operation programs in the OAS or funds for entrepreneurs to invest in cleaner production technologies.

A principal idea from economics states that economic efficiency requires that costs must be less than the benefits of any economic activity. This is difficult to ensure for

pollution related activities as most pollution results in "externalities", that is the costs are borne by others while the benefits accrue to economic agents who do not bear these costs. Therefore at a minimum, to draw the attention of firms to the issue, mechanisms are required to let the costs be borne by the polluter. This requires some form of pollution charge set at a reasonable level.

The traditional methods of pollution control have been command-and-control (CAC) regulations. Pollution charges and other market based instruments on the other hand attempt to align private costs with social costs through pollution charges and provide a degree of flexibility to the producer in selecting the mechanisms to achieve a given environmental target. The literature shows that by providing incentives to control pollution or other environmental damages, these systems have lower private compliance costs and can also provide much-needed revenue for local government coffers. Ideally large fractions of this should be earmarked for supporting the costs of the R&D, demonstrations and information systems for new and cleaner technology solutions. As we see later, while the concept of the charges are not new, their levels, the implementation and the use of the resources can be improved.

In the area of applications of cleaner technologies, a problem often is the lack of demand for their application; as a result, existing and readily available solutions are not applied as widely as is desirable. Obstacles include a lack of access to financing and weak environmental regulations. For many immediately attractive, economically and environmentally efficient technologies, inadequate financial structures do not direct investments and recapture the costs from the savings stream. Solutions will require many larger developments, of which restructuring and increased competition, international financial participation and changes in macro-policy are important. But narrower policies of pollution charges and their effective uses can alleviate many barriers.

Many measures, such as increasing energy efficiency and going beyond improved housekeeping measures require an initial investment, but also have a high rate of return. Promoting such efficiency improvements require a variety of institutional measures. In such cases, the availability of intermediary institutions like the energy services consulting firms (ESCOs) operating successfully in some industrialized countries can be very useful. Such energy service companies, which have emerged in the Canada and USA over many years, are embryonic in other countries, are an example of a major organizational and institutional innovation that needs to be more widely developed in the region.

SUBSIDIES AND MARKET DISTORTIONS

The elimination of market distortions, the removal of subsidies, and institutional restructuring can also release significant financial resources and overcome various obstacles to greater use of clean technologies. Acceleration of present moves in the countries to realign prices will increase both the demand for conservation and efficiency and the demand for cleaner technologies, as well as generate much-needed financial resources.

INFORMATION

Tietenberg states that information strategies constitute the third wave in the development of pollution control policies. The first wave consisted of setting up legal regulations to monitor and limit emissions; the second wave involved imposing pollution charges and other market-based instruments. Here information strategies include both public and private efforts to increase information available on the different pollution emissions - their source, trends, and toxicity as in the PRTR systems. The World Bank supported the PROPER information system developed in a co-operative effort between firms, communities and governments, (see World Bank, 2000) on information on the solutions that have been tested and verified, and on available clean technology options and sources. Information constraints affect firms, researchers, the communities and wider public and also governments. Programs designed for each are needed.

At firms, most managers, especially those operating in environmentally sensitive industries, and in smaller companies, are afraid that they must invest substantial resources to reduce environmental damage. Most see only these costs, which are expected to negatively affect their costs, profitability, competitiveness and ultimately their viability. But we have reviewed and provided many examples where the "cleaner" technologies paradigm overturns traditional concepts and the applications of many cleaner technologies are clearly "win-win" solutions for the companies in that they reduce the environmental impact while at the same time increasing overall efficiency, reducing costs and resulting in higher profitability and competitiveness. While we provided only a few examples here, it is important to document many more cases from the hemisphere, by country, by specific technology application and by sector of use and disseminate this information, especially to decision makers in firms and in SMEs. This increases their knowledge and develops the confidence levels of

entrepreneurs to adopt cleaner technologies. This must be an ongoing initiative supported by demonstrations and verification programs for newer technologies.

Technology purchasers always face disadvantages, including inadequate knowledge regarding both technology needs, the range of technologies potentially available to meet those needs and the risk of change. A requirement to improve adoption is to provide adequate, ongoing assessments of clean technology options. The technology verification programs developed in Canada and USA provide an institutional mechanism to verify and certify the performance of cleaner technologies. In the interviews in developing countries among researchers, policy makers, regulators and industrial firms, on barriers, the most common theme relates to a lack of appropriate information, This is one area where there is a need for more detailed studies of what exists, which users are taking advantage of the services, who is being left out and what their specific information needs are.

There are informational constraints on the supplier firms and research institutions as well. In any new and emerging field, the nature of future applications is not immediately apparent such that estimation of potential markets is difficult. Canada and the US have in place several excellent mechanisms for coordinating information on needs and technologies, which can easily be expanded to allow easier access by hemispheric countries in areas of priority to them. Clearly defined public procurement programs for cleaner technologies can also assist the suppliers of technology.

NETWORKING

Networks, consortia and alliances differ widely in terms of institutional form, conditions of membership, and objectives that range from pre-competitive research, technology development; standard setting; joint service provision and bench marking and sharing best practices. For the purposes of this discussion, several types of networks can be useful.

New hemispheric networks for technology development. One possibility worth exploring is the scope for new networks or consortia focused specifically on environmental problems facing developing countries of the hemisphere. Priority sectors could be in solar and other renewable energy technologies, and, technologies most relevant to key economic and environmental sectors of the region.

Localized, problems solving networks around local firms. There is considerable scope to improve joint efforts to overcome environmental problems in sectors, which are important in developmental terms, have high levels of environmental impact and are

dominated by smaller firms (e.g. tanning; textile dyeing, some agro-industrial products). Localized alliances could help to diagnose problems and work with outside agencies (including development banks) to implement packages of solutions.

Learning about the experience of countries in the use of different policy instruments can be an important area for co-operation in the hemisphere. Because of the technical and administrative requirements of regulatory actions, regulations should be used selectively. One potentially important area of co-operation is in the design of regulatory systems appropriate to the condition and administrative capabilities of the individual countries in the region. For this, there is a need for "twinning" and similar co-operative arrangements between public institutions in the region**.**

There is also considerable scope for technology co-operation among non-competing users to solve common problems. This is the case, for example, with a network of utility companies in North America, Europe and Japan, called the E-7, which are developing co-operative programs in some countries on cleaner energy. In the case of emerging technologies and pre-commercial research, significant progress can be made in funding research partnerships between developing country and industrialized country researchers in both public and private sector institutions. Some existing bilateral programs have moved in this direction and provide interesting models in this regard. The US has several interesting technology development and dissemination programs under way in partnership with several developing countries. These are so far more oriented towards Asian countries and some of them could be initiated for the Americas.

A number of hemispheric initiatives towards networking and information sharing exist in an embryonic form and these need to be strengthened.

MARKET STIMULATION

Increasing the demand for cleaner technologies first requires a minimum set of environmental regulations. *Environmental regulations are seen as drivers of demand in the OECD countries, and are weak or lacking in many countries of the hemisphere.* Increasing standards for efficiency and emissions are considered to be the driving force behind the achievements of large efficiency gains within firms and market penetration of cleaner alternatives in many sectors. In a survey of firms with environmental technologies, the OECD reported that they find the lack of demand for clean technologies in many countries stems primarily from the lack of appropriate environmental standards and regulations. In the industrial sector, regulation can be

categorized into two types, specified compliance that depends on specific rules and tends to result in end of pipe technology, and negotiated compliance, which depends on flexible guidelines and bargaining. The latter is thought to promote greater innovation and efficiency, leading to more productive changes to the core technology. It is important for many of the hemispheric countries to develop standards appropriate to their circumstances as often overly strict standards lead to end of pipe solutions while a lack of standards militate against the adoption of any environmental technologies.

Ultimately, ensuring an adequate flow of technology depends on the efforts to create a market for environmentally sound products and services. Country governments can also have a considerable effect on more rapid technology adoption by the judicious use of procurement provisions in public sector investment. Both the USA and Canada have set out principles of public sector procurement, which will lay down standards favoring cleaner products and processes. Here hemispheric co-operation can help pooling markets, not only nationally but regionally, thereby increasing scale, encouraging efficiencies and reducing costs. This will require hemispheric co-ordination to set joint standards for products, services and technologies.

THE CURRENT SITUATION IN THE REGION

Before we move on to recommendations for further actions at the national and hemispheric levels we need to take a quick look at some of the developments in the region and the results.

We have already mentioned and made use of the data from the US TRI and the Canadian NPRI registers of emissions to discuss some of the issues related to the size and scope of wastes and emissions in North America. The same data set has been used by the World Bank to make preliminary estimates of emissions in a number of developing countries. We can also use the same data to explore the macro impacts of the new regulations and the increased emphasis on pollution prevention and cleaner production at an aggregate level in those two countries beyond the individual firm level cases that we have provided earlier.

The TRI and NPRI data show that for many of the emissions, the changes of approach from the earlier methods of “ignore, dilute and disperse” to the newer prevention approaches, have important positive results at the firm level both in reducing pollution and often accompanied by increased efficiency and financial gains reported earlier. Also, they are also beginning to show reductions and impacts at the

national levels in both Canada and US. We provide a few examples here from the 1998 US trend data and the taking stock report prepared by the CEC for North America in 2001.

Looking at three of the criteria air pollutants, NOx, SO_2, and lead defined for the US by EPA, we find some amazingly positive results of the policy and technological changes which were begun in the US in the nineteen seventies. Actions to reduce lead emissions began in 1970s and the emissions of lead have been most dramatically reduced from over two hundred thousand tons per year in 1970 to less than four thousand tons in 1998. Actions on SO_2 began in the seventies also. It moved through an initial emphasis on low sulfur coals, to “end of pipe” scrubbing and now augmented with new trading regimes. The results show a decline of total SO_2 emissions by over 40% in two decades at the aggregate national level. Within the national figures, there are spectacular results from certain sectors such as a decline of 97% in emissions from copper production. Similarly, with new requirements on utilities introduced in 1995 there has been a 40% drop in this sector in three years. Unlike the case of lead or SO_2, there was little focus on NOx till recently. So emission levels have been steady, but they are not growing for the past decade due to the other pollution reducing actions. New guidelines on NOx introduced recently should begin to show more dramatic reductions in the future.

In another study conducted by the CEC (CEC, 2001) looking at Canadian and US data on emissions and P2 activities, the following conclusions emerge. In 1998 the total release of listed emissions in Canada and the US were a little over one billion Kg. But this has declined by 4 percent between 1995 and 1998. Comparing the releases with the reported P2 activities by firms, it was seen that those that reported P2 contributed to a reduction of 22% in Canada and 11% in the US. The firms that did not undertake P2 activities reported increases of emissions or small decreases.

Unfortunately we do not have data of similar depth for other countries in the region. But there is some data available for the key parameters for air pollution in the recent work by ECLAC and UNEP for Latin America.

Emissions of	1970	1990	1999
Particles	111	188	200

SO_2	1,873	3,452	4,194
NOx	2,668	5,761	8,123
CO	10,334	21,555	27,693
CO_2	420,283	922,274	1,165,238

(Amounts in gigagrams; Source ECLAC, p 77)

The above results are in dramatic contrast to the trends and results cited earlier for the same pollutants in Canada and the US. While in North America there have been reductions of these by 50% or more, in Latin America there has been a growth of between 200 to 300% over the same time period. On lead, ECLAC reports that “lead emissions remain a major problem”. This is largely due to vehicles still using leaded gasoline in most countries and results in high lead levels in blood.

ECLAC and UNEP state that the information on all other hazardous wastes remains scanty. But rough estimates suggest that the production of heavy metals, chemicals, and hazardous agricultural residues are doubling every 15 years in Latin America.

This comparison shows the importance of having data for making policy and it shows what is possible with appropriate actions. It suggests the importance of developing PRTR systems most appropriate to each country in the region. In fact the UNCED decisions called for similar systems to be established in all countries (Chapter 19 of Agenda 21). This was endorsed by the OECD in 1996 for all member countries and most OECD member countries have begun common agreed upon national systems. Mexico has begun a smaller voluntary system in 1997 spurred by NAFTA. The importance of PRTR has recently been endorsed by the International Forum on Chemical Safety (IFCS) at its meeting in Brazil last year. Clearly the value of PRTRs is being more widely recognized and momentum is building towards their wider adoption. Given the rich existing experiences in the hemisphere on PRTRs this can be easily taken up for early implementation by the OAS members and it can build upon the capacity developed by UNDP at the national level for data collection.

In the energy production sector, the performance of Latin America is comparatively cleaner than the world averages because of lower availability and use of coal and much higher ratios of hydro electricity in total energy production (though it should be noted that the recent evaluation of hydro electric production no longer provides large

dams with a clean environmental record). In recent decades the main growth in energy use has come from oil for transportation, which is growing rapidly. To a certain extent the increased emissions from energy production are counter balanced by increased use of natural gas a relatively cleaner fuel. But the most worrying trend is that the intensity of energy use, or the energy required to produce one unit of output, rose by 7% in the past two decades while in the OECD countries energy intensity has declined by 20% over the same period. There is little sustained effort to promote the newer and cleaner renewables.

For the Latin American countries we have a number of examples and more scattered information on activities and progress. The Bank notes that government actions such as warnings, fines, penalties, and court actions, in most Latin American countries, and specifically in Mexico, Chile and Argentina, have increased significantly in the past decade.

The Bank's review of 11 Latin American countries shows that there has been substantial experimentation with pollution charges and other market based instruments in the region. It states that while a wide range of mechanisms have been developed and applied in all the countries investigated, their primary and historical role has been only to raise revenues. The dual objectives of reductions of environmental impacts and improving the cost-effectiveness of regulations have not been emphasized. A broad based effort has been promoted by the UNDP through the Capacity 21 program, launched shortly after UNCED in the region. This program has supported the development of local capacity for broad sustainable development goals and objectives. Thanks to the program, many of the smaller countries of the region now have an Environmental Action Plan that seek to integrate different issues, such as sustainable energy, national and local environmental data with social and economic needs. Many have resulted in increased public awareness of the issues and options, and the collection of national data for the first time. A number of them have shown excellent progress and could avail of additional assistance from the OAS.

The major generic problems have included low public awareness, the lack of strong institutions, adequate legislation, and, effective monitoring and enforcement. The major institutional weaknesses include underfunding, inexperience, unclear jurisdiction, and lack of political will. Without these, many perverse incentives remain and opportunities for improved performance are lost. Yet, the World Bank also cautions, that too often international agencies recommend OECD solutions to all countries with little regard to local issues and capacities. It states, that most of the

information flow regarding solutions have been of a "North-South" variety and there is substantial opportunity and benefits to all parties to share environmental management experiences among countries in the region by increased *information sharing* on a "South-South" basis. This should be noted in the design of any OAS actions which should combine the best from North America with the experiences and needs of other countries.

The reasons for poor environmental performance of firms in Mexico are reviewed by the CEC, and, also by Dasgupta. Both the reviews confirm the broad patterns of barriers described earlier and found in most country reviews of cleaner technologies and their applications. Survey evidence from Mexico reveals large observed differences in pollution from factories in the same industry, and in the same area, operating under the same regulatory regime. Poor environmental performers made less effort to change materials and production processes; they had fewer training programs for their workers; they lagged behind in environmental and waste management, environmental policy and administration, and clean technology and audits. The main barriers included capacity and information gaps on environmental policy, on pollution control requirements and options. Finally, among the key barriers the perennial one of high cost of finance and a lack of an environmental protection culture were found to be important.

DIRECTIONS FOR HEMISPHERIC ACTIONS

The cooperation efforts must be directed to promote technological change towards greater environmental sustainability. The status and level of technological capability in a country, will depend on the knowledge acquired through basic research, the diffusion or transfer of new technologies both within and across national boundaries, their adaptation and incorporation into productive activities, and the process of incremental improvements to production systems. The ultimate goal of developing cleaner technology lies not in applying particular technological solutions, but in enhancing the capabilities of countries and more specifically the economic agents to select, import, assimilate, adapt, and create the appropriate technologies. Moreover, efforts to develop the internal technological capabilities in the poorer countries needs to be given appropriate importance.

Successful hemispheric cooperation requires the cooperation between the richer and poorer countries, the more industrialized and the less, and the larger and smaller countries. To achieve such cooperation the environmental priorities must be decided keeping in mind individual country priorities and the resources required for dealing

with them need to be shared appropriately. Within the hemisphere, the more industrialized and the less industrialized countries often have different perspectives on the issues of the environment; with many poorer countries being more concerned about possible conflicts between environmental goals and the economic development goals. Yet, there are emerging signs that a focus on clean technologies, which are better for the environment and for the economy, can provide consensus between the countries. There is increased recognition that any effective strategy must involve technological co-operation, among which training, experience sharing, networking and co-operative research and information systems are critical. Efforts must increasingly focus upon the so-called "soft" technologies such as regulation; structures, emissions and monitoring, industrial and competition policy, management practices, and so on. Financial, informational, and institutional constraints remain the most immediate barriers and must be included in any effort.

Co-operative activities are always complex and can be deemed to be costly. But judicious and well designed co-operation can be less costly and more effective than independent and uncoordinated efforts. It has the potential for major benefits for all parties in the cooperation program. This stems from the enormous potential magnitude for clean technology transactions in the region. Very large percentages of the new capacities in certain sectors such as energy, pulp and paper, aluminum and other primary sectors will be installed in the region in the near term. The benefits include not only those accruing to the individual firms utilizing the cleaner technologies but also to the suppliers of technology and finally to the larger public in improved quality of life.

For the group of technologies, which are especially relevant to the smaller and poorer countries of the region, some special measures will be required. These needs should be made more broadly known to researchers and technology suppliers in the industrialized countries, and also special efforts must be made to support increased research and application in the countries where the applications art expected. To list detailed priorities, one must have better estimates of environmental costs and the likely economic, financial and environmental benefits by sector. Instead of a prioritized list, the approach taken here is to provide a list of promising directions for possible technological development and co-operation. The purpose is to stimulate and help guide the ongoing dialogue on how regional international collaboration may help accelerate the pace of adoption and diffusion of existing cleaner technologies and how to ensure that future technology development efforts address the needs of the member countries and includes the participation of the smaller and poorer

countries. This report should enable the working group in cooperation with the OAS to identify specific activities for greater attention and to select individual and groups of activities that could be pursued within future programs of cooperation.

RECOMMENDATIONS

Priority elements for an action program should first document the actions taken under the existing initiatives in environmentally oriented cooperation and technical assistance in the hemisphere some of which are listed in the annex one. A number of countries in the region have also established special funds to finance co-operation with other members of the Organization of American States, especially in the area of human and institutional capacity building. Efforts have included courses, internships and technical visits in the areas of agriculture, energy, health, environment, public administration, and education. It would be useful for the OAS to examine the extent to which these programs include work on cleaner production and ensure that co-operation with industry, on technology transfer and enterprise development are being given adequate attention.

A variety of technology support institutions have been created over the past two decades and there is need for careful study of which approaches have been more successful, and under what circumstances. Special attention needs to be given as to the extent to which existing institutions and programs have been successful in reaching smaller, and marginalized firms.

It is recommended that the Ministers mandate the OAS to organize further background studies and consultation in each of these areas, in order to identify feasible initiatives, to report on institutional policies and mechanisms available and develop a strategy of action.

Following this, actions will be needed to address major information barriers, such as:

- Lack of information about the sources, types and amounts of pollution is the first priority that needs to be addressed by individual countries, building on the public disclosure programs established in the US, Canada and now in Mexico. Without wider awareness and exact data, it is not possible to motivate polluters, or policy makers and there is little scope for public pressure. This also allows for hemispheric co-operation in building such an information base.

- Initiatives to support national regional and sectoral institutions providing access to information about, and assessments of, technologies, with special attention

for the poorer countries and for smaller firms

- Sectoral studies of environmental management and adoption of cleaner technologies (what are the environmental challenges in specific sectors? What range of technological solutions is available? What are the main incentives for and barriers to adoption of new technologies? How do improvements in environmental management affect firms' profitability and competitiveness? What scope exists for new financial or institutional arrangements to promote cleaner technologies?)

- Mechanisms to share knowledge on the development of regulatory structures and enforcement mechanisms, and the role of charges, economic instruments and performance based measures.

- Actions to facilitate the transfer of technologies, know-how, and experience.

- Creation of Benchmarks and instruments to assess, monitor and encourage best practice standards at the firm level on a sectoral basis where the likely impact will be high.

- Support to the development of information technology applications, for information sharing and environmental education and training, such as electronic seminars, manuals, newsletters and data bases.

- Policies to increase the investment in the intangible assets skills, know-how needed within firms for effective use and assimilation of cleaner technologies.

- The scope for market coordination to assist both in the development of technologies and for their utilization.

- Some form of "strategic research competition, rather than a capacity-building approach; this would be peer-reviewed competition, geared to supporting path-breaking technological development, open to both public and private sector institutions and has been used successfully in the USA..

- Review of existing programs of financial support to development of clean technologies and intangible technological assets, exploration of alternative financial mechanisms, including consultation with multilateral and national development banks. One key issue is how financial mechanisms can be designed which would be effective in reaching smaller firms, either individually or collectively.

- Detailed evaluation of specific institutions providing technology information

and assessment services to small firms; documentation of lessons for design of future mechanisms promotion and support of local problem-solving consortia among local firms to tackle common environment problems.

These will allow the development of effective programs to assist firms (either individually or via consortia) to overcome some of the barriers to "win-win" investments in environmental improvement. It may be possible initially to develop an initiative focused on one or two relatively mature industrial branches, which would work to provide the full menu of information, financing and human resource development to assist firms to achieve joint environmental and efficiency gains.

CONCLUDING REMARKS

The report makes clear that environmental damage need not be an inevitable consequence of industrialization, technological advance and economic growth. New technologies already available provide a wide range of solutions to recognized problems, and potential future technologies hold out the prospect of even more radical solutions. Fortunately, a range of relevant technologies for reducing pollution already exists. The range of available technologies and others that can be available in the near term is impressive.

There is substantial evidence that in the short and medium term, at least, the perceived trade-off between reducing environmental damage and encouraging economic growth and development is not as rigid as often assumed and that the application of appropriate technologies and policies can result in increases in economic efficiency and contribute to further economic growth in all countries in the hemisphere. But for real progress attention needs to be paid to social, political, structural and economic issues as well as technological ones. Both technological and social innovations are required. Technology is by no means a panacea to environmental degradation, but it remains an essential tool for the diagnosis of environmental problems and the strategies to find solutions. Finding a balance between roles and responsibilities of the state, business and civil society is requisite for a reorientation of technology aimed at harmonizing environmental and developmental concerns Social and economic structures influence the nature of technological change, and conversely, new technology has influence over society and economic production. The attraction of building on areas of common interest that are potentially “win win” for all stakeholders is that initial and successful actions can also help to increase the likelihood of longer-term, more comprehensive and more costly measures, both by demonstrating the potential for reversing current trends and by

generating the experience and confidence necessary to support longer-term and more far-reaching initiatives.

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ANNEX ONE: OAS MANDATES BY PREVIOUS SUMMITS AND RELATED ACTIONS

The 34 member countries of the OAS have identified an impressive number of priority programs for joint action at previous summits (see OAS (2001)). Naturally, included among the 25 major priorities are education, a key input to science and technology and to sustainable development, and also more specifically cooperation in Science and Technology, Energy and Sustainable Development.

A very useful system for the systematic follow up on actions has been developed by the Organization. On July 6, 1998, the Secretary General of the OAS established the **Office of Summit Follow-up (OSFU)**, which ensures the coordination of summit-related issues within the Organization and serves as the institutional memory for the process. The office also provides technical support to the Special Committee on Inter-American Summit Management, and to the Summit Implementation Review Group (SIRG).

The General Secretariat of the OAS, through its Office of Summit Follow-up, provides support with respect to substantive issues as well as technical support to the SIRG. The Office has developed an Information System for Summits of the Americas. This Internet site, http://www.summit-americas.org, was launched in late October 1998, completed in early March 1999 and is continuously updated. It contains the official documents of the SIRG, the Special Committee for Inter-American Summit Management, as well as specific documents on the mandates of the Summit Process. The Web site also contains, under a restricted section, all negotiating documents for the Summit Process.

The summary below of the mandates and actions in the areas pertaining to this paper are taken from the above source.

The main programs in our areas of interest include:

OAS Inter-American Science and Technology Program

OAS The Renewable Energy in the Americas Initiative

OAS Inter-American Program for Sustainable Development

ECLAC Regional Meeting on Information and Communications Technology

ECLAC Technical assistance in economic evaluation of energy cooperation actions at the sub regional and regional level

ECLAC Mainstreaming of sustainability issues in the implementation of development strategies and policies at the national level

IDB Strategy for Science and Technology

IDB Program for Financing Energy Services

IDB Sustainability of Power Sector Reforms Initiative

WB Through the Global Environment Facility (GEF), cover incremental costs for projects in the areas of climate change, and Ozone depletion

WB Millennium Science Project

Below we provide a short summary of the actions in each of these areas as reported by the agencies.

SCIENCE AND TECHNOLOGY

SUMMIT MANDATES

- *Recognize that science and technology are related to various areas and objectives of this Plan of Action….*

- *Continue implementing the Cartagena Plan of Action, agreed to in 1996, with emphasis on strengthening the capacity of the countries in the Hemisphere to participate and benefit from the knowledge-based global economy, promoting, among other actions, the growth of the communications and information industries as strategic components of national, subregional, and regional integration processes. In the context of the Cartagena Declaration, recognize the important role that existing regional institutions play in implementing this Plan of Action.*

- *Promote actions to foster alliances to advance cooperation and innovation in science and technology. It is recognized that university-industry relations, training in technology management and other human resource development programs, as well as participation of small and medium-sized companies, are important elements for utilizing science and technology to achieve hemispheric objectives*

ACTIONS

In 1999 the **OAS** adopted the **Inter-American Science and Technology Program**, approved by the Inter-American Council for Integral Development (CIDI) as a part of the Strategic Plan for 1997-2001. Member governments also instructed CIDI to promote the implementation of the Program, with the assistance of the Inter-American Commission on Science and Technology (COMCYT), in coordination with the Executive Secretariat for Integral Development and the Office of Science and Technology.

IICA has collaborated with member States, helping them to develop a greater capacity to:

a) draft technology policies

b) create and consolidate national, regional and hemispheric systems

c) facilitate international transfer of knowledge

d) facilitate institutional development for the sustainable management of natural resources

The **IDB** has supported the Summit initiatives in the area of science and technology on two fronts, namely the development of a Bank strategy in the sector and special initiatives to deal with the impact of weather phenomena in the region. The IDB has made contributions to building national capacities in science and technology and has boosted human and physical infrastructure, especially in universities; strengthened science-funding agencies, especially by channeling funds to peer reviews and open competitions; encouraged private-sector investment in research and development through technology-development funds.

In 2000 the IDB Strategy for Science and Technology was approved. This emphasizes a systems approach; an increased role for technology; and continued, but more focused, support of science research and training; increased support for smaller, poorer countries, and a parallel increase in support for education and training, which will impact, both directly and indirectly, science and technology capacity in the region. Particular importance is given to the development of close links between science and technology funding and organization in each country and the nature of its economic activity. The Bank has undertaken a number of regional activities and discussions in this area.

Since the Santiago Summit, the IDB has approved seven loans in science and technology for a total amount of US$ 400 million, and fifteen technical cooperation projects in the amount of US$ 4 million.

Through the **Regional Fund for Agricultural Technology** (**FONTAGRO**) the IDB has also promoted strategic agricultural research of relevance for the Latin American and Caribbean Region (with direct participation of the countries of the region in priority setting and funding of research projects). FONTAGRO is consolidating its endowment fund, which promotes science and technology investments to increase the competitiveness of agriculture, while protecting natural resources and reducing poverty in the region.

The World Bank is supporting the Summit goal to stimulate international alliances and innovation in science and technology. Specifically, the Bank is supporting the creation of several centers of excellence in science in the region. The Bank is already financing two such centers in the region, one in Chile the other in Venezuela. Also, the Bank is using a new lending instrument to provide this support. This instrument entitled "The Learning and Innovation Loan" provides small amounts of money quickly, up to US$5 million per project, to support innovative ideas and has allowed the Bank to be flexible and quick in responding to country requests for assistance in support of Summit goals.

The OAS developed the **Inter-American Strategy for the Promotion of Public Participation in Decision-Making for Sustainable Development (ISP)**. The unique hemispheric instrument, agreed upon by the 34 OAS member States, to advance public participation contains the basic principles, goals, and policy recommendations aimed at achieving greater involvement of all sectors of society in decision-making for sustainable

development, and the *Recommendations for Action*, six areas of recommendations were developed Information and Communication; Legal Frameworks; Institutional Procedures and Structures; Education and Training; Funding; and Opportunities and Mechanisms.

REGIONAL ENERGY COOPERATION

SUMMIT MANDATES:

Support the following actions in continuing the cooperation efforts through the Hemispheric Energy Initiative:

- *Promote policies and processes that facilitate the trade of products, goods and services related to the energy sector.*
- *Give impetus to, in the shortest possible time, policies and processes that facilitate the development of infrastructure, including across international boundaries, to further the integration of energy markets.*
- *Foster the creation and strengthening of transparent and predictable regulatory systems, which take into account the needs of the different parties involved.*
- *Promote legal, fiscal and regulatory systems in order to stimulate local and foreign private investments in the energy sector in those areas permitted by respective Constitutions.*
- *Increase access of rural inhabitants to energy services.*
- *Support policies and programs that will stimulate the development of renewable energy and energy efficiency.*

Ministers of Energy of the Americas met in New Orleans, Louisiana, July 28-29, 1999, for the **Fourth Hemispheric Energy Ministers Meeting** to evaluate the progress towards the fulfillment of goals previously adopted; to share experiences about the energy integration process and discuss ways to make further progress in this area, to discuss the importance of the clean development and use of energy, to encourage the energy business sector established in the Hemisphere to organize itself into a Business Forum; and to consider the extension of the current Coordinating Secretariat.

The Ministers adopted the New Orleans Declaration and a Joint Statement on Clean Development and Use of Energy. The Ministerial also produced an Energy Business Forum of the Americas, designed to facilitate an interchange of ideas and perspectives between the business sector and government officials of the energy sector on issues related to the implementation of the commitments on energy adopted in the Action Plans of the Miami and Santiago Summits of the Americas.

The Renewable Energy in the Americas (REIA) Initiative, an OAS program run by the Unit of Sustainable Development and Environment, is working throughout the region to promote environmentally clean development through the use of renewable energy and energy-efficient

technologies. REIA works closely with energy Ministers and financial institutions to develop means for implementing programs in these areas.

The **IDB** has increased the scope and depth of its analysis of energy projects and have adopted a new Energy Strategy after extensive consultations. The Bank has pioneered lending for renewable energy, energy efficiency and conservation in the region. Seeking the transfer of technologies and knowledge, the Bank has also sponsored energy-efficiency conferences through its Sustainable Markets for Sustainable Energy (SMSE) Program, in which the energy Ministers and utility executives of borrowing countries interact with experts from the United States, Canada, and Europe.

Seeking to help overcome barriers to the adoption of Sustainable Energy in the region the Bank conducted during three years a technical cooperation program. As a follow up the IDB has launched - in cooperation with the U.S. Department of Energy - the **Program for Financing Energy Services in Latin America and the Caribbean**. The objectives of this program are to: (i) integrate renewable-energy and energy-efficiency services in the design of energy strategies in Latin American and Caribbean countries; (ii) identify bankable, sustainable projects for funding by multilateral and bilateral donors acting in concert with the host country and national and international private-sector participants; (iii) facilitate the financing of renewable-energy technologies and conservation initiatives for small-scale energy users through the identification and utilization of in-country financial institutions, working with support from the Bank; and (iv) improve the quality of life in urban and rural communities by providing low-cost and environmentally beneficial energy technologies that utilize indigenous renewable resources, as well as by promoting savings through energy conservation. The Bank has already made three loans for end-use energy efficiency and conservation and is supporting the preparation of another three.

The IDB's **Energy Strategy,** approved in March 1, 2000, after a thorough consultation with governments and Civil Society, is focused in helping countries to face the following challenges:(i) the consolidation of the structural and regulatory reforms, (ii) the provision of universal service with modern technologies, (iii) the development of production and energy consumption patterns which are efficient and compatible with the environment, (iv) the difficulties of finding and committing financial resources for energy projects, and (v) the integration of transnational energy markets as a key step in the process of economic integration.

The **OAS** has a program the Inter-American Program for Environment Technology Cooperation in Key Industry Sectors. **The Inter-American Program for Environment Technology Cooperation in Key Industry Sectors**, is a joint OAS - International Development Research Center ("IDRC", Government of Canada) - World Association of Industrial and Technological Research Organizations (WAITRO) initiative that responds to the challenges faced by small and medium size enterprises in Latin America and Caribbean countries to adopt cost-effective, environmentally sound technologies and management practices. The purpose of the program is to better equip industry associations to deal with the

environment management concerns of their membership and bring them together with organizations which can assist them with follow up initiatives, thus creating a support network in the Hemisphere.

- The "cataloging" of technologies developed and tested by CEPIS. For example: in-situ generators of water disinfectants; simplified water treatment units; school sanitation for healthy schools; manual drilling of wells, etc.

- Preparation of a "Technology Manual" in hard copy and electronically, on water supply and sanitation. This consists of a catalogue of available technologies including descriptions of conditions necessary for implementation.

- *Develop mechanism for assessment of the effectiveness, cost and efficacy of those technologies to be introduced to cope with these and other relevant health problems.*

SUSTAINABLE DEVELOPMENT

SUMMIT MANDATE

- *We recognize the effort made by the Organization of American States (OAS) in terms of follow-up of the Sustainable Development Summit, and instruct it, through the Inter-American Commission on Sustainable Development, to continue coordination related to fulfillment of its mandates. We ask the entities of the Inter-American System and the United Nations to strengthen cooperation related to implementation of the Santa Cruz Plan of Action.*

OAS activities under the project **Coordination and Follow-up to the Santa Cruz Plan of Action** and the **Inter-American Program for Sustainable Development** pursuant to Chapter II of the Santa Cruz Plan of Action continued in the period between 1998 and 2001.

The Unit for Sustainable Development and Environment of the OAS functions as the Chair of the **Inter-Agency Task Force (IATF)** coordinating the implementation of the sustainable development mandates. The IATF has established seven Working Groups, each in charge of the principal initiatives from the Bolivian Summit. More information on these working groups can be found on the OAS/OSFU Web site.

Pursuant to the Summit mandates, **IICA** has incorporated into its strategic and operational sphere the institutional task of supporting member States in the sustainable development of agriculture and the rural environment. In October 1998, The Institute developed a new priority for the integral management of natural resources, in particular land and water resources, which are of interest for agriculture. Some of IICA's accomplishments include:

- Articulation and completion of actions, on the management of agriculture-related water resources, with regional institutions.

- Elaboration of the Hemispheric Program for the Conservation of Soil, Water and Agriculture-related Water Resources.

- Promotion of National Conservation Programs of Natural Resources, in particular those related to genetic resources, which are of interest for agriculture and nutrition.

- Support, in collaboration with the IDB, of the National Program of Water Basins Management and Soil Conservation (PRONAMACHCS) in Peru.

Currently the **IDB** has issued over US$5 billion in environmental loans. In 2000, the commitment for new loans was US$531.3 million out of which about one-fifth was directed to natural resource conservation, two-thirds to the urban environment, one-tenth to natural disaster, and about two percent to environmental management. Some of the IDB programs for sustainable development include:

- An on-going relationship with other members of the OAS Interagency Task Force on Follow-up to the Santa Cruz Summit on Sustainable Development.

- The IDB maintained a strategic alliance with UNDP, UNEP, the **World Bank** and **ECLAC** to support the work of the **Forum of Environmental Ministers** of Latin America and the Caribbean.

- The IDB approved a new Energy Strategy. The central objectives of the Sustainable Markets for Sustainable Energy (SMSE) Program is to act as a catalyst for establishing these markets in a context of economic and sectoral reform, restructuring, and decentralization.

- The IDB has also started to implement the new Strategy on the Private Sector and Environment. There are already 10 projects underway for the financing of the Multilateral Investment Fund (MIF) of the IDB for this Strategy.

- In the area of trade and environment the Bank approved a technical-cooperation project with resources from the Netherlands Environment Trust Fund that will support the MERCOSUR Working Group on the Environment in the further development and implementation of its work plan.

COOPERATION

SUMMIT MANDATE

- *With the intention of achieving a greater impact in […] national and collective efforts, [governments will] charge national agencies and organizations responsible for international cooperation with supporting the preparation and implementation of programs and projects which flow from the Plan of Action. Moreover, [governments] request the participation of the multilateral cooperation institutions with the same objective.*

Since the Inter-American Council for Integral Development (CIDI) was created, six Inter-American Programs in the area of cooperation have been adopted: Sustainable Development, Education, Science and Technology are three areas out of the six. CIDI's grant financing instrument, FEMCIDI, represents the most consistent source of multilateral project support for Inter-American Summit commitments.

The Inter-American Agency for Cooperation and Development was established at a Special OAS General Assembly held November 15, 1999. This new OAS Agency, coming under the auspices of CIDI, began operations on January 1, 2000 and is expected to provide a more integrated approach to cooperation and development within the Inter-American system as a whole. The Agency is specifically designed to complement, at the operational level, the Organization's role in policy dialogue and the convocation of high-level meetings on hemispheric development issues. In addition to its principal emphasis on the planning and implementation of cooperation projects, it will give very high priority to promoting institutional strengthening in member States, human resource development through training and fellowships and mobilization of additional human and financial resources for Inter-American cooperation.

- *The OAS Secretariat will be assigned responsibility for operating as a record-keeping mechanism (the institutional memory of the process) and for providing technical support to the SIRG.*
- *In accordance with Summit decisions, international organizations will have responsibilities in implementing this process and, as appropriate, according to Summit mandates, support will be provided by private sector organizations and civil society.*
- *In the case of specific mandates that require the convening of sectoral ministerials, these meetings, when appropriate, will take place under the aegis of the OAS Inter-American Council for Integral Development. Moreover, the OAS, IDB, PAHO, and ECLAC, as appropriate, will lend technical support to the meetings, the results of which will be reported to the States through the OAS Secretariat.*

ANNEX TWO: USEFUL MATERIAL: SOME DEFINITIONS, WEB SITES FOR CLEANER PRODUCTION AND CASE STUDIES

Cradle-to-Grave or Manifest System - A procedure in which hazardous wastes are identified as they are produced and are followed through further treatment, transportation, and disposal by a series of permanent, linkable, descriptive documents.

Criteria - Descriptive factors taken into account by EPA in setting standards for pollutants. For example, water quality criteria describe the concentration of pollutants that most fish can be exposed to for an hour without showing acute effects.

Life Cycle Assessment (LCA) provides a systematic approach to measuring the use of resources/inputs and the release of effluent to the air water and soil during the lifetime of a product, from its manufacture to its disposal.

Public Environmental Reporting is the process by which businesses, factories, governments and other organizations examine their environmental performance and publish the information to the general public.

Environmental Indicators allow the measurement of environmental impact caused over a defined time period. They are essential to determine how well firms and other organizations are improving their "eco-efficiency". Indicators may range from the very simple to the very complex.

Industrial Ecology involves the incorporation of cleaner production principles into the planning of industrial developments and other projects to optimise environmental protection and cost effectiveness.

Eco-Efficiency involves increasing production while reducing the environmental pressure per unit produced.

Environmental audits are carried out to identify all of the environmental impacts made by a firm. They are normally carried out before the implementation of cleaner production so that changes to practices and processes can be identified and assessed.

Environmental Management Systems (EMS). There are two main Environmental Management Systems the ISO's ISO 14000 and the European Union's Eco-Managment and Audit Scheme (EMAS). The ISO (International Organization for Standardization) (http://www.tc207.org/faqs/index.html) defines an Environmental Management System (EMS) as "a systematic approach to dealing with the environmental aspects of an organization. It is a

'tool' that enables an organization of any size or type to control the impact of its activities, products or services." EMS is not prescriptive -- it doesn't specify how environmental targets should be met -- but rather provides a framework in which organizations can examine their practices and then determine how these can be managed.

Environmental Accounting involves the implementation of accounting systems that take into account environmental costs such as waste treatment and disposal costs and the costs of a poor environmental reputation.

Environmental Labeling involves including labels on products which inform potential purchasers of the product's environmental impact. These labels require a standard for comparing products.

Performance Based Contracting has been used mainly in the energy sector. It involves a third party contractor taking responsibility for running a portion of the business. The contractor can get financial rewards for making the business more efficient.

Pollution - Any substances in water, soil, or air that degrade the natural quality of the environment, offend the senses of sight, taste, or smell, or cause a health hazard. The usefulness of the natural resource is usually impaired by the presence of pollutants and contaminants.

Pollution Prevention - Actively identifying equipment, processes, and activities which generate excessive wastes or use toxic chemicals and then making substitutions, alterations, or product improvements. Conserving energy and minimizing wastes are pollution prevention concepts used in manufacturing, sustainable agriculture, recycling, and clean air/clean water technologies.

Toxic Chemical - Substances that can cause severe illness, poisoning, birth defects, disease, or death when ingested, inhaled, or absorbed by living organisms.

Toxic Release Inventory (TRI) - A database of annual toxic releases from certain manufacturers compiled from EPCRA Section 313 reports. Manufacturers must report annually to EPA and the states the amounts of defined toxic chemicals that they release directly to air, water, or land, inject underground, or transfer to off-site facilities. EPA compiles these reports and makes the information available to the public under the "Community Right-to-Know" portion of the law.

Toxic Substance - A chemical or mixture that can cause illness, death, disease, or birth defects. The quantities and exposures necessary to cause these effects vary widely. Many toxic substances are pollutants and contaminants in the environment.

Toxicity Characteristic Leaching Procedure (TCLP) - A test designed to determine whether a waste is hazardous or requires treatment to become less hazardous; also can be used to monitor treatment techniques for effectiveness.

Sustainable Agriculture - Environmentally friendly methods of farming that allow the production of crops or livestock without damage to the farm as an ecosystem, including effects on soil, water supplies, biodiversity, or other surrounding natural resources. The concept of sustainable agriculture is an "intergenerational" one in which we pass on a conserved or improved natural resource base instead of one which has been depleted or polluted. Terms often associated with farms or ranches that are self-sustaining include "low-input," organic, "ecological," "biodynamic," and "permaculture."

The classifications and summary descriptions on this page are based on the Government of Australia's Eco-efficiency and Cleaner Production Homepage. This is available at http://www.ea.gov.au/industry/eecp/index.html .

Other useful sites include:

New Ideas in Pollution Regulation - Economics of Industrial Pollution Control Research Project - Related Papers -- http://www.worldbank.org/nipr/work_paper/index.htm -- World Bank working papers and case studies related to pollution control in the developing world.

Cleaner Production Case Studies Directory -- http://www.environment.gov.au/epg/environet/eecp/examples.html -- The Eco-Efficiency and Cleaner Production Examples and Case Studies directory details mechanisms for improving environmental and economic efficiency in industry. Each case study provides information on a specific site and outlines the initial problem, how it was solved using cleaner production approaches and the economic costs and benefits. Search by industry, location, etc. Produced by the Australian Government's Environmental Protection Group

New Zealand Cleaner Production Case Studies -- http://www.arc.govt.nz/cp/aindex.htm -- This site presents a number of Cleaner Production case studies from New Zealand for various manufacturing industries, retail trade, business services and government administration.

LEAD China Case Study Catalogue -- http://www.lead.org.cn/Data/Case/index.html -- Chinese case studies in various sectors. (English and Chinese)

Institute of Environment and Development Case Studies -- http://www.ied.org.cn/Case/index.shtml -- Chinese case studies in various sectors. (English and Chinese)

Horizons Solution Site -- http://www.solutions-site.org/ -- solutions to vital concerns in the areas of health, population, development and the environment. Sorted by sector or country.

EnviroSense Case Studies -- http://es.epa.gov/cooperative/topics/casestudies.html -- US case studies, and links to more case studies

World Environment Center -- http://www.wec.org/publicat.htm -- case study books and videos

Environmental Accounting Project -- http://www.epa.gov/docs/opptintr/acctg/casestudy.htm -- The intent of these case studies is to demonstrate how the application of environmental accounting principles can have a direct, positive, bottom-line effect on business operations.

International Study of the Effectiveness of Environmental Assessment -- http://www.environment.gov.au/epg/eianet/case_studies.html -- an international collection of case studies of good practice EIAs. Includes template for case study preparation.

Case Studies on Persistent Organic Pollutants (POPs) -- http://www.chem.unep.ch/pops/default.html -- see the bibliography section prepared by UNEP

Pollution Prevention Resources -- http://www.p2gems.org/ -- searchable collection of case studies and more

Canadian Pollution Prevention Success Stories -- http://www.ec.gc.ca/pp/english/stories/listing.html -- by sector

Eco-Efficiency Case Study Collection of the World Business Council for Sustainable Development -- http://www.wbcsd.ch/eedata/eecshome.htm -- case studies showing how efforts to improve ecological impacts can translate directly into bottom line cost savings, etc.

Environmental Technology Best Practice Programme -- http://etbpp.netgates.co.uk/chemicals/index.htm -- case studies and other publications

Making Business Sense of Energy Efficiency and Pollution Prevention -- http://www.aceee.org/p2/p2cases.htm -- a range of industries have implemented projects or overall corporate strategies that profit from the synergies of energy efficiency, pollution prevention, process efficiency, and increased productivity

UNEP TIE Manufacturing Case Study Collection -- http://www.emcentre.com/unepweb/tec_case/manufact.shtml -- an excellent collection of case studies funded by UNEP in various countries; broken down by sector.

Pollution Prevention Case Studies --http://www.p2pays.org/case/case.asp -- from North Carolina, well organized - by sector and pollution category.