



Developing countries can avoid the mistakes made by the industrialized world by introducing cleaner technologies from the outset.

Transferring technologies

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While environmentally sound technologies (ESTs) need to be used more widely throughout industry in the developed economies – particularly among small and medium-sized enterprises – the imperative is to accelerate their introduction and use in developing countries. The fastest growth in population and economic activity in the years ahead will occur outside the Organisation for Economic Co-operation and Development (OECD) countries, and with increased economic growth comes increased pollution. This is not simply a ‘local’ issue: as many developing countries industrialize at a rapid pace, they contribute increasingly to global environmental problems. Transferring state-of-the-art ESTs, held mostly by the OECD countries, and training people to use them is essential to meet this challenge. But there are a number of barriers to successful technology transfer and these need to be overcome if the use of ESTs is to be accelerated.

As far as environmentally sound technologies (ESTs) are concerned, developing countries need to make the same changes as those implemented in a number of industrialized economies. They need to:

- replace environmentally damaging industrial processes with environmentally superior alternatives;
- reform manufacturing practices to cut materials use, energy consumption and pollution;
- improve existing technologies, largely transferred from countries that industrialized earlier or, better still, replace them with new ESTs.

Indeed, many developing countries, starting out on the process of industrialization, have an ideal opportunity to leapfrog the ‘dirty stages’ in technological development and avoid the developed world’s mistakes. It would be to every developing country’s advantage to implement cleaner technologies from the start because it would help them to:

- compete in world markets with goods and services that meet international standards;
- reduce pressure;
- minimize environmental damage.

Despite this, the take-up of new technologies outside the Organisation for Economic Co-operation and Development (OECD) countries is disappointing: 87 per cent of investment in ESTs is still in Japan, North America and Western Europe, though the market for them is increasing in parts of Asia and Latin America. This suggests that while there may be a demand for ESTs in developing markets, there are a number of barriers to technology transfer. These barriers include lack of information, lack of funding, intellectual property rights, royalties and lack of skills in managing ESTs in developing countries.

Success factors

Transferring ESTs successfully depends on the potential recipient:

- understanding their benefits;
- obtaining information, and having the knowledge and tools to make an assessment;
- understanding how to implement and manage technological change successfully.

The United Nations Commission on Sustainable Development (CSD) says that if “any of these elements is omitted or seriously deficient, successful technology transfer will be

Laying the foundations for strong, sustainable growth for Egypt

Egypt is one of the fastest-growing emerging markets. A strategic location, a labour force of 17 million and the region's lowest-cost producer make it the perfect manufacturing base and entry point for the Arab, Asian and African markets.

The private sector is leading this surge for growth, exports and jobs. Boosted by a major economic reform programme which includes investment incentives and tax exemptions, it already accounts for 60 percent of Egypt's GDP, and this will reach 85 percent by the year 2000.

The Ezz Group – a 100 percent privately-owned company – is at the heart of Egypt's economic renaissance. The company began trading in 1959 handling the local distribution of steel and construction materials. In 1987, the group expanded into industry, investing over \$300 million in the steel and building materials sectors. Today, it is a major manufacturer of steel rebars and coil, and one of the country's largest producers of high-quality ceramic and porcelain tiling, exporting to 40 countries.

The Ezz Group understands its responsibilities as an engine for growth. To compete in the global market, it has invested heavily in modern facilities supported by advanced technologies. A key objective has been to establish a technologically sound and enduring industrial base, balanced by environmental management systems.

It has taken no short cuts: its facilities exceed current national environmental protection requirements and set an example for other industrial investors. To date, over \$19 million has been invested in:

- Water Treatment Plants

The Group has followed strict regulations requiring all water wastes to be free of hazardous chemicals and suspensions upon discharge. Al Ezz Steel Company has three water treatment plants: for its rolling mills and its steel meltshop, for water purification, chemical treatment, water cooling, sludge treatment and oil and grease removal. Al Ezz Ceramics and Porcelain Company has an integrated dedusting, water recycling and purification system.

- Fume Treatment Plants

Al Ezz Steel has equipped its plants with systems – including 600 tons of steel fabricated ducts – to collect gases and treat dust, and generate a clean environment throughout the plant. Al Ezz Ceramics and Porcelain factories are similarly equipped.

- Anti-Flickering Systems

These systems control flicker pollution resulting from the Arc Furnace operation inside the 220 kV national electric grid.

The Ezz Group achieves high productivity levels thanks to top industrial technology and stringent quality control and management. Its investment in pollution control systems reflects an effort to reconcile the conflicting needs of industry and the environment.

Through technology transfer, human resource development and environmental control systems, The Ezz Group is laying the foundation for strong and sustainable growth for industry and for Egypt.



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difficult". It also points out that, increasingly, the issue for many developing countries may be access not to a particular technology, but to the process of technological change to achieve cleaner production. UNEP stresses that "the benefits and advantages (of ESTs) need to be more widely understood and appreciated", and in particular "much more emphasis is needed on their economic benefits, as well as on their ability to produce improved products and services".

Companies – whether in developed or developing countries – essentially have two motives to adopt ESTs. One is because they have no choice: legislation forces them to meet mandatory environmental standards. The other is because they understand the economic benefits of reducing raw materials and energy use, waste and pollution. Legislation and regulations are important as well, as they can, for example, penalize polluting industrial processes.

Knowledge gap

Even though ESTs clearly add value, and provide a good return for firms, large sections of industry – mainly, though not exclusively in developing countries – remain unimpressed by the benefits. Indeed, there remains a large and worrying knowledge gap generally on ESTs. Time and again, companies in developing economies say they do not know what technologies are available. For example, 50 business leaders from the Middle East told a workshop organized by DELTA (Developing Environmental Leadership Towards Action) in September 1996 that "lack of awareness of alternative technologies" was a major obstacle to improving their corporate environmental performance.

This information gap is a critical constraint on the transfer of ESTs. "The ability to obtain information on available technological alternatives is the first step towards making greater

BOX 3.1

Bottom-line benefits are persuasive

Evidence of improved financial performance is a key factor in persuading firms to adopt environmentally sound technologies (ESTs). This has certainly been one of the reasons for the success of a programme to promote pollution prevention in the Philippines, funded by the United States aid agency USAID under the Industrial Environmental Management Project, and focused on small companies.

An outside expert visits the company, identifies areas and opportunities for introducing waste minimization, and prepares a report for the management on what to do before making a return visit to check on follow-up action.

Initially, companies were reluctant to volunteer for the scheme. However, because so many of those that did take part reported big cost savings from adopting the expert's recommendations, there has been a surge of volunteers. Some are even willing to pay for what was originally a free scheme. One other result has been the emergence of a market for environmental management consultants.

Most of the changes proposed to companies cost little or nothing which helps explain why, when introduced, they yielded significant savings in operating costs. High-cost recommendations have not been adopted as a general rule. "More time is needed to convince small businessmen that such expenditure would eventually be recouped, and some businessmen are also waiting until law enforcement becomes truly efficient to justify the high cost of such recommendations."

The Philippine Business for the Environment organization drew the clear conclusion that an essential factor in the successful introduction of new ESTs to a developing country was "evidence of profitability" because "local entrepreneurs cannot afford to invest in undertakings whose returns are more social than economic". The fact that foreign consultants effectively demonstrated the new processes *in situ* (that is, in the local environment) was also important. So too was the fact that there was a reasonable level of local capability in science and engineering.

use of ESTs and upgrading systems of production ... the future widespread adoption of ESTs in developing countries will largely be an exercise in improved information exchange and capacity-building", says the CSD.

According to UNEP: "Solutions to many environmental problems may already exist. They have been developed worldwide, and implemented by institutions and communities.

BOX 3.2

Barriers to technology transfer

Reports produced at a 1995 workshop in Geneva, organized by the United Nations Commission on Trade and Development (UNCTAD) and the United Kingdom government, confirmed the difficulties in transferring environmentally sound technologies (ESTs) to developing countries.

Three hundred companies in Argentina were surveyed on adopting environmental management systems and cleaner technologies, and five major barriers were identified:

- lack of information;
- lack of qualified personnel;
- lack of know-how to use the technologies;
- a confusing regulatory framework;
- financial requirements.

"Developing countries are discouraged from using ESTs", it said, "because the costs of new ESTs are greater than those of existing 'polluting' technologies; there are insufficient financial resources to cover the incremental costs; there is a lack of new resources, or information about existing resources, that are specifically for ESTs." The report also criticized the "insufficient information disclosure by producers of ESTs", which "weakens the developing country's product choices and negotiating advantages, and reduces the likelihood of appropriate EST transfer decisions".

In another report, the Economic and Social Commission for Asia and the Pacific stressed the importance of helping developing countries acquire the necessary technological and managerial capabilities. "There is a need for change in the ongoing efforts to promote the transfer of ESTs. These efforts appear to concentrate for the most part on using imported equipment and expertise to achieve a one-shot environmental improvement – rather than laying the basis for self-sustaining paths of increasing efficiency in the future."

As part of the research process, and at the request of the parties to the Montreal Protocol's Multilateral Fund, UNEP is currently conducting a study of the barriers related to the transfer of ESTs to replace ozone depleting substances.

Yet, knowledge of these solutions appears not to be global. Developing countries and countries with economies in transition in particular, may be unaware of the range of technological alternatives available to solve the specific environmental problems they face. Likewise, they may not know that a large number of these solutions are in the public domain, in some cases are free of charge, and can significantly contribute to alleviating pressures on the

environment for both developed and developing countries."

Why is there such a lack of knowledge about ESTs when there are a number of information channels already available through research centres, databases, national and international information systems and industry associations? (see Box 3.3). According to the CSD, the problem is that there are no specific support structures to facilitate technology transfer. Other factors that could account for the lack of transfer are that the mandates and financing of these information systems are not specifically oriented to developing countries. Indeed, many serve developed countries only. In addition, many private companies do not want to release technologies because frequently there is little guarantee they will be adequately compensated – by royalty fees, for example.

Plugging the gap

There is a consensus that the need is to strengthen the existing channels, rather than create new ones, and that:

- country-based information access points are important, for example coordinated and networked with other facilities for technology transfer, such as centres for training, demonstration and transfer of ESTs;
- information sources should be close to the end-users so they know of their existence and can access them easily, and they should provide fast answers to end-users' questions;
- information itself must be driven by demand, not supply, so that it is based on user needs;
- information should also be clear and specific: why ESTs are needed, what ESTs are available, their costs, benefits and drawbacks, and how and where to get them.

End-users also need to know about cases where ESTs failed, and why. For example, was the technology inappropriate or was lack of training to blame?

Intermediaries crucial

The role of intermediaries is crucial. They provide information on technologies, identify information sources or arrange access to the technologies themselves. Intermediaries are mainly international, governmental or non-governmental environmental organizations, university research centres and training institutions.

As the first point of contact with end-users, the intermediary is responsible for passing on relevant information about ESTs, which may come from information systems in developed countries. This information may influence the end-user's choice of technology or know-how. The intermediary must be able to recognize and meet the end-user's specific needs as companies and industries in developing countries are often unsure what questions to ask about improving their operations. The intermediary has to help form the questions, then provide the answers. He or she can also play a significant role in the contacts between EST suppliers in developed countries and customers in developing countries. The intermediary has a marketing role to promote awareness of their services and ultimately awareness of ESTs and their benefits. Dissemination of information materials and provision of seminars and training programmes are ways to do this.

Other issues

Language is another barrier to information access, since most of the materials available on ESTs are in English only. The cost of accessing a database can also be a deterrent, which raises the issue of whether information should be free, at least at the initial stage when an intermediary is trying to raise awareness of ESTs among potential end-users. A UNEP-organized meeting of experts in Paris in 1995 proposed establishing a consultative mechanism in the form of an EST information system network – a loose-knit network of

organizations and institutions using and supplying information on ESTs.

Reaching small and medium-sized enterprises

Small and medium-sized enterprises (SMEs) are often neglected in the transfer of ESTs, for various reasons: their sheer number; their relative lack of capital, knowledge and technical capabilities; and the difficulties suppliers face in identifying and contacting them. The Industrial and Technological Information Bank of the United Nations Industrial Development Organization (UNIDO) found that information on ESTs was mostly targeted at developed, not developing, countries, compounding the problem of reaching SMEs in developing countries.

Smaller enterprises frequently have limited financial resources, which is one of the barriers to implementing ESTs. Lack of access to information is a further obstacle. There is also the problem of the SMEs' own attitude towards new technologies: they rarely have an 'information culture'; adopt a passive attitude to information; and are conservative about making changes to their existing practices.

A study by UNEP's Cleaner Production Programme in conjunction with the World Business Council for Sustainable Development (WBCSD), and with financial support from the European Union, is reviewing the current global situation of SMEs to address the following questions:

- what information do enterprises need?
- what information is available?
- what additional information should be provided?
- how is information delivered and how could delivery be improved?

Globally, environmental problems faced and posed by SMEs are similar, and they seem to be exacerbated in developing countries. SMEs account for a large percentage of economic activity and therefore have a major



ENVIRONMENTAL COMMITMENT MEANS SOCIAL RESPONSIBILITY

Cerro Matoso S.A. (CMSA) in Colombia, South America, is part of the Australian group QNI Limited, the fourth largest nickel producer in the western world. CMSA is a leader in ferronickel production – contributing 3 percent of the world's output through opencast mining and the advanced technology process of pyrometallurgy. It has the world's largest electric furnace, uses smelting technology for processing nickeliferous laterites, and uses expert and simulation systems for process control. CMSA exports over 30,000 tonnes per year of ferronickel granules to customers in Europe, Asia and the United States, where they are used mainly for the production of stainless steel.

CMSA's vision is to be a leading company in the production of ferronickel at world level, contribute to the sustainable future of its region, and to be the favourite place to work in Colombia. Its mission is to achieve efficient, economic management of nickel deposits, provide high-quality ferronickel to its customers, promote the development of its staff and the contribution of each employee to the company's success, and contribute to the progress of the region where it operates and that of Colombia.

CMSA aims for continuous improvement through a process of total quality and initiatives such as management of loss control, an occupational health programme, an environmental management system, a quality insurance system, a development, education and training plan, and managers leading by example.

CMSA is fulfilling its commitment to creating a sustainable future for the region of Montelibano, 400 kilometres south of the port of Cartagena in Colombia, through a number of ambitious social and environmental programmes. These include having set up three foundations:

- the Fundación San Isidro to contribute to the welfare of the local community
- the Fundación Educativa Montelibano to provide quality education for employees' children and other children in the region
- the Fundación Panzenú to provide family health care services.

The Company has also:

- set up a community nursery to provide CMSA with garden plants and timber-yielding trees for reforestation projects

Indicators of eco-efficiency

General aspects 1997

Economic aspects:

Exports	US\$167 million/year
Payment of royalties	US\$5 million
Taxes	US\$15.2 million

Productivity:

Prior to 1990, the annual average increase in production was 8%; after 1990, production has increased by an average of 18%. It should be noted that this improvement in productivity is associated with a more efficient use of energy.

Employees:

Direct	725*
Indirect	2,500
Average years of service:	13

*71% of whom are inhabitants of the Region

Industrial safety and health:

Decline in LTI (Loss Time Injury Frequency Rate). This has been declining gradually, both for CMSA workers and contractors, from 9.8 and 9.7 respectively in 1992 to 2.7 and 4.2 in 1997.

Human resources development programme in 1997:

- Total participants: 1,951
- Training/person per year: 69 hours

Investment in social development of the Region (US\$ millions)

Fundación San Isidro	US\$1.0m
Community support	US\$0.4m
Fundación Educativa de Montelibano	US\$2.7m
Fundación Clinica Panzenú	US\$1.4m
Channelling of external resources to benefit the community	US\$1.1m
Total in 1997:	US\$ 6.6m

Impact of Environmental Management

Programmes

- Continuous improvement by Total Quality Management Programme
- Implementation of the environmental management programme ISO 14001
- Quality assurance by ISO 9002
- Implementation of the International Loss Control System to manage safety on-the-job and off-the-job
- Implementation of an integral plan for management of all waste products within the CMSA operation

Examples of impact

- Recycling of ore fines to the smelting process
- Reduction in the energy consumption of the electric furnace from 450 kWh/t ore in 1991 to 390 kWh/t ore in 1998
- Substitution of electric power by gas in certain parts of the operation
- Installation of energy consumption measuring devices to improve management of energy resources
- Improvement of cyclone designs and gas scrubbers to reduce emissions in drying, calcination, smelting and refinery
- Erosion control measures by revegetation programmes
- Installation of sediment ponds
- Installation of process water treatment facilities
- Optimization of process water recycling
- Washing stations for mine equipment to minimize runoff of oil and grease into surface water
- Improvement of blasting techniques to reduce noise and vibration levels
- Creation of recycling company to manage industrial and municipal waste disposal
- Research into the re-use of slag, a byproduct of the smelting operation

- supported microenterprises producing paving blocks and other products for the local construction industry
- promoted the REASER Recycling, Cleaning and Service Enterprise to solve the town's waste problems
- had the initiative to turn metals and other retrievable materials into a commercial business, with the profits invested in the Fundación San Isidro
- helped local farmers to achieve self-sufficiency through fish production, cattle raising and cultivation of general crops.

The Company is running a development programme for employees, who are predominantly from the region, to learn new skills to create opportunities for other income sources. It has also organized courses for housewives to learn new skills offering possibilities to increase their family income.

CMSA – one of the first companies to be awarded ISO 9002, implements a Total Quality Process, and an Environmental Management System based on ISO 14001 for continuous improvement in environmental performance, reducing its environmental impact and conforming to international standards exceeding Colombian legal requirements.

It manages atmospheric emissions through a range of emission control equipment such as electrostatic precipitators, scrubbers and bag filters in order to comply with Colombian law and with internationally accepted standards.

Process effluents are treated before discharge into the

environment. Monitoring programmes are in place to manage and minimize the impact of the mining activity on the environment.

Between 1992 and 1997, CMSA replanted 90 hectares of forests, including replanting the slag dump, an inert and immobilized byproduct of the smelting operation. The REASER Company is processing the industrial waste of the CMSA operation to achieve maximum recycling and final disposal in an environmentally responsible manner.

CMSA is proud of what it has achieved.

In 1997, CMSA invested US\$6.6 million in the social development of the region, helping to improve the quality of teacher training, promoting women's leadership in family care, improving schools, health centres and nurseries as well as housing, providing advice to 910 enterprises and instilling a sense of confidence in the local community.

Over the years, CMSA has managed to reduce particulate emission levels, reduce energy consumption, optimize waste recycling and disposal, and reduce accidents and personal injuries while at the same time improving productivity levels. At CMSA, quality, safety, occupational health and environmental protection have priority over the levels of ferronickel production.

CMSA is committed to helping to create a sustainable future for the local community and the region as one of the elements of its environmental commitment.

BOX 3.3*Information systems surveyed*

How easy is it for companies to find out about environmentally sound technologies (ESTs)? How much information is available? Can businesses find it? Is it useful? In recent years, there has been a considerable increase in the number of databases and information systems – public, private and international – dealing with different aspects of ESTs. Yet complaints continue about the lack of information.

UNEP has conducted two surveys to find out where the information is, how to access it, and how much it costs. From a questionnaire sent to over 400 United Nations agencies and organizations, other international and national agencies, industrial organizations, research groups and other bodies, UNEP identified 84 systems containing some information related to ESTs – 33 including “substantial” information. Of these 33:

- 53 per cent contained information on energy conservation, and alternative and renewable energy supplies;
- 47 per cent included information on water pollution control and water supply;
- 44 per cent covered air pollution control;
- 41 per cent covered cleaner production;
- 34 per cent contained information on solid waste management;
- 31 per cent had information on greenhouse gas emissions and alternatives to ozone depleting substances;
- 22 per cent had information on hazardous waste management.

Half the 84 systems had information on ESTs collected on an international basis – the rest had information from only specific countries or regions. Only 14 were located in developing countries.

The survey found there had been a “dramatic” increase in on-line systems (to 75 per cent). Over 50 per cent provided the information in hard copy or printed form (47 per cent), while 18 per cent included a query response service by telephone, fax or mail. Some 32 per cent of the systems were free, but 54 per cent charged for information. Information was provided to virtually anyone by 82 per cent (though many of these charged), while 14 per cent restricted information to particular users.

environmental impact, but their small size and isolated nature makes influencing their behaviour difficult. A small enterprise usually has limited access to necessary information to address environmental issues, and a limited infrastructure to handle them.

In the European Union, 70 per cent of economic activity is carried out by SMEs, but a variety of factors, including difficulties in

accessing information, keep a majority of them from meeting applicable environmental regulations. In developing countries, the percentages of SME economic activity are similarly high, but usually coupled with a less well-established regulatory structure. Recently, there has been global recognition of the important role SMEs play and of the need to address them.

A UNIDO study of SMEs in India found that they were more interested in short-term profit than long-term investment, so environmental improvements had a low priority; operational standards were low, with a limited capacity to appreciate and absorb new technology; they showed a general lack of awareness of the technical aspects of the environment; and in general they were reluctant to invest in new, clean and efficient technologies unless forced to do so. UNIDO commented that these results could probably apply to other target audiences in other countries. Specific measures to address the SMEs include making technology suppliers aware of developing countries’ needs and the potential market opportunities, and informing technology buyers in developing countries about the availability of ESTs.

Skills management

Even when companies know about particular ESTs, they may still face two further potential hurdles before they can introduce them into their operations: deciding which are the right ones to choose and invest in; and being able to operate them effectively. There have been cases of technologies being transferred which have harmed, not protected, the environment. The infrastructure to manage ESTs is part of the building of users’ capacity to assess and use them successfully. Both the assessment process and the infrastructure component are part of what is called ‘soft’ technologies. Both hard and soft technologies need to be present for effective technology transfer and implementation.



Small enterprises often lack the infrastructure to access, process and implement the information necessary to address environmental issues.

BOX 3.4*Asia and Pacific focus on small and medium-sized enterprises*

The Asian and Pacific Centre for Technology Transfer in India has 20 years' experience in moving environmentally sound technologies (ESTs) into developing countries. Its focus is squarely on small and medium-sized enterprises (SMEs). "An important challenge facing SMEs in the region is to keep abreast of new technological and cleaner production developments, and to apply these where relevant. SMEs are often too busy with routine problems to take the long-term view that is essential for technological innovation."

The centre's activities have concentrated on developing business contacts, creating networks, forming partnerships, and organizing various technology promotion events and training programmes – all aimed at creating a better environment for the transfer of ESTs. The number of negotiations facilitated by the centre rose steeply between 1990 and 1994, from about 250 to 2,500. The centre attributes this to a number of reasons, including understanding SMEs' needs and creating a demand for ESTs through its own "aggressive" marketing activities. The big increase in demand for ESTs "proves that if one technology transfer centre turns 'greener', it can help hundreds of SMEs to become more environmentally friendly".

The centre says that partnerships, networking and technology brokering have emerged recently as key components in technology transfer. It now has more than 1,000 partners in about 70 countries. Networks it has established include the Asia-Pacific Mechanism for Exchange of Technology Information (METI) and the International Network for Transfer of Environmentally Sound Technologies (INTET).

METI is a United Nations Development Programme funded project, aimed at creating a regional network for collecting and disseminating information on ESTs available for transfer to SMEs in the region. Eleven countries participated in the first phase (1991-1993) and more than 300 network members were trained. INTET is targeted at SMEs and technology consultants and brokers. The package includes: information on ESTs, business and investment opportunities; search for partners worldwide; technology financing; consultancy sub-contracts; and marketing assistance. About half of INTET's members are manufacturing companies. And it is a self-sustaining network with 75 per cent of its income coming from services, 20 per cent through membership fees, and the rest from the sale of information.

Users need to assess how the ESTs will act under specific conditions: in short, will they work for my company and address my problems? Those assessments need to be sector, even project, specific. Some basic criteria or

general guidelines for evaluating environmental performance will be important in transferring and applying ESTs (see Chapter 13). The infrastructure to transfer and manage the technologies requires adequate technical and managerial skills, a trained workforce, programmes to maintain and upgrade technologies, access to funding and adequate energy, transportation and other support systems.

The lack of skilled people in user companies, particularly, but not solely, in developing countries, is a serious bottleneck in technology transfer. The OECD has noted that the skills needed to use a particular technology effectively do not automatically lead to a mastery of the skills required to change or adapt it. There must be a conscious effort of 'technological learning', which requires substantial resources. Buyers of ESTs must not only acquire the technologies – they also need to acquire the capabilities to operate, maintain and adapt them. Technology sellers can help with long-term training packages. There remains, however, the problem of a general lack of environmental management capabilities, in particular in SMEs. Remedying this situation will demand a big rethink on training. Increasingly, the focus on achieving skills in specific disciplines will have to switch to improving interdisciplinary and intersectoral training.

Key role for private sector

Agenda 21 urges that "governments and international organizations should promote, and encourage *the private sector* (emphasis added) to promote effective modalities for the access and transfer, in particular of developing countries, of environmentally sound technologies", through a variety of interrelated activities. Multinational companies have already emerged as a significant force in the transfer of ESTs thanks to the increase in global trade and international business activities. By some estimates, transnational corporations may control as much as 70 per cent of world trade.

Direct investment is one way (see Chapter 4). But the mobility of labour (as well as capital) which multinationals and transnationals provide also offers the potential for enhancing technology transfer, and promoting education, training and information exchange. The sale of ESTs from one company to another is another piece of the transfer jigsaw.

In its *Changing Course* report to the 1992 United Nations Conference on Environment and Development in Rio, the Business Council for Sustainable Development (predecessor of the WBCSD) said unequivocally that technology transfer – which it called technology cooperation – “works best through business-to-business long-term partnerships that ensure both parties remain committed to the continued success of the project”. It added: “Technology cooperation is likely to be most successful when it happens within a commercial setting. Both the provider and the recipient companies will have clear, self-interested motives to make the deal succeed.”

The elements of long-term partnerships, the report explained, include a commitment to business development, training of employees, adapting, improving and upgrading ESTs, and introducing new management systems. It acknowledged some concerns among companies that since competitive advantage is invariably based on technological innovation, transferring technology can mean transferring competitive advantage. However, long-term partnerships seem to allay their fears because they lead to an expansion of business for companies in the developed countries, not loss of business through selling their technologies.

Most multinationals however have few qualms about transferring ESTs – certainly to their own subsidiaries. They recognize the need to be as clean abroad as at home. The Environmental Charter of the Japanese business group, the Keidanren, for example, gives ten guidelines to Japanese companies operating

BOX 3.5

Transferring ESTs to small and medium-sized enterprises in Morocco

An action plan is being developed by the Moroccan government and the United Nations Industrial Development Organization (UNIDO), aimed at tackling the problem of small and medium-sized enterprises that pollute. The absence of any national legislative or institutional controls has allowed industrial activities to take root which, while providing badly-needed jobs, have also created air and water pollution problems.

Large-scale factories could afford to import modern technologies with built-in pollution control devices. But small and medium-sized family enterprises were in a different situation. They had limited access to capital to upgrade their operations, and little or no information on how to do so themselves. UNIDO reports that “the notion that an industry does not necessarily have to be polluting in order to be competitive, and that there is a technological solution to the problems, was often greeted with astonishment. The fact that profits are even increased when wastes are reduced also seemed odd.”

In 1991, the Moroccan government asked UNIDO to help prepare a strategy for including ecologically sustainable industrial development in its economic development plans. Work started in 1992, funded by the Belgian government, and also involved the United Nations Development Programme (UNDP), the United Nations Educational, Scientific and Cultural Organization (UNESCO) and the World Bank. Now, the Moroccan government and UNIDO are developing an action plan of priority areas to attack degradation at its source in industries causing the most pollution, as well as introducing measures to prevent pollution occurring in the first place.

An environmental audit is being conducted of the key industries – food, beverages, textiles, tanneries, chemicals and metals. The aim is to identify projects to transfer cleaner technologies, using incentives provided by the government. Other measures include a database on environmentally sound technologies (ESTs), with linkages to other national and international information centres, and joint committees of the industry and environment ministries and the private sector.

overseas. These include applying Japanese standards to the management of harmful substances, providing local communities with information on environmental measures, and cooperating in promoting the country’s own environmental policies.

The performance of multinationals in developing countries can often be – and



Environmental protection is an integral part of Alcan's way of doing business.

At Alcan, we have been working for more than 20 years to continually reduce the impact of our operations on the environment. We have achieved substantial gains; we intend to build on these and to make further strides.

Our commitment to environmental excellence starts at the top of the company – Alcan's President and CEO sits, with five outside directors, on a board-level environment committee that reviews environmental policy and management systems, monitors their effectiveness, and sets long-term goals.

Our company-wide environmental management system conforms to ISO 14001 and incorporates the best practices from around the world – with responsibility for implementation given to line management locally to ensure that activities take into account internal, local and global concerns.

Each plant is responsible for establishing its own environmental priorities within the framework of the corporate environmental management systems structure, by

-  identifying significant aspects of its operations that are likely to affect the environment – including raw material use and energy consumption, as well as emissions
-  assessing the adequacy of its production control and pollution prevention technologies
-  setting clear targets to manage any risks associated with emissions and reducing all forms of waste including those associated with energy, water and material consumption
-  establishing action plans with defined responsibility and accountability for achieving targeted improvements, including opportunities for re-using and recycling materials, or finding replacement materials or processes that generate less waste and emissions

 monitoring and measuring emissions to assess progress versus targets and to evaluate air and water quality

 monitoring consumption of energy, water and raw materials to aim for "plant best" or "world class" performance

 ensuring that capital expenditures include funding for process changes and technological improvements.

Implementing each plant's plan is directly linked to the personal performance objectives of managers and employees. Top management reviews plant, business sector and corporate performance annually and sets new goals for subsequent years.

Alcan also operates a Product Stewardship programme that uses life cycle information to benchmark performance against competitors, and against competing materials in specific product applications. This programme demonstrates to suppliers, customers, consumers, governments, other industries and other groups, that we are committed to ensuring that our products – at every stage of their life cycles – make the most of aluminium's unique combination of properties. Its high strength to weight ratio, corrosion resistance, thermal and electrical conductivity, barrier properties and economical recyclability make aluminium an environmental choice for a wide range of uses.

Alcan believes that aluminium use is on the threshold of unprecedented growth. We want to build and strengthen partnerships with all kinds of external communities – other like-minded companies, government agencies and environmental groups – so that we can harmonize our actions and resources to ensure delivery of our commitment to environmental excellence.

At Alcan, protection of the environment is no longer viewed as only another cost of doing business; it is our way of doing business.

“ Achieving sustainable development is perhaps one of the most difficult and one of the most pressing and promising goals we face. It requires on the part of all of us commitment, action, partnerships and, sometimes, sacrifices of our traditional life patterns and personal interests ”

Mostafa Tolba,
Chairman of the Commission on Sustainable Development

“ Humankind is rapidly reaching the threshold of sustainability, and we must adjust urgently ”

Ljerkamintas-Hodak,
Deputy Prime Minister of Croatia

“ If we are not doing what needs to be done, it is certainly not for lack of knowledge. Since Rio, we have shared more knowledge of what is right and wrong than ever before ”

Poul Nyrup Rasmussen,
Prime Minister of Denmark

increasingly will be – an important influence on local industry, including SMEs. The local subsidiaries of multinationals are an important source of information and technical assistance for SMEs. Multinationals can also insist that their suppliers conform to their environmental quality standards.

Public sector approach

Most major developed countries run programmes to support the transfer of ESTs to developing countries: some examples are highlighted below.

- The United Kingdom is increasingly focusing on private sector operators. Its Technology Partnership Initiative promotes direct access by companies in developing countries and newly industrialized countries

to information about ESTs available in the United Kingdom, and firms that can supply them. At the same time, the initiative is trying to raise awareness among United Kingdom suppliers about the markets and needs for ESTs in developing countries.

- Denmark’s International Development Assistance Agency helps promote the use of ESTs in developing countries. A sister organization, the Industry Foundation for Development Aid, has sponsored a number of cleaner technology projects in China, India, Poland and several African and Latin American countries.
- The Canadian International Development Agency assists Canadian companies to form joint ventures with developing country partners and also provides financial support.

The ventures are aimed at testing, adapting and demonstrating ESTs for possible transfer. Other Canadian federal departments and organizations disseminate information on cleaner technologies.

- The Netherlands has a programme of grants to investment projects in the industrial sector with a positive environmental impact, and which must be innovative and involve either existing or new ESTs. The aim is to act as a catalyst for similar actions in various industrial sectors. Examples include wind generators, solar home energy systems and organic waste management facilities.
- Australia's AusAID gives preference to supporting overseas projects that meet local needs, create jobs and involve appropriate ESTs and local skills. One example is the use of ESTs in East Java, Indonesia, to support pollution prevention activities. A private sector linkages programme includes the demonstration, adaptation and supply of proven and appropriate Australian technology.
- Germany sponsors the German Investment and Development Agency, which promotes technology transfer between private sector companies in Germany and developing countries. It has also established an International Technology Transfer Centre to assist SMEs in establishing contacts in Asia and Eastern Europe.
- Norway finances technology cooperation and capacity development programmes on waste minimization and EST strategies in a number of countries. Some of them aim to increase industrial productivity through ESTs, for example, lower material spillage, water use and energy usage. The programmes include on-the-job training.
- Japan sends teams of technology and environment experts to live and work in developing countries to learn about capacity, infrastructure and the cultural setting

for technology cooperation, and then provides assistance in developing the right environment to use various types of ESTs efficiently.

- The United States, through its Environmental Pollution Prevention project, supports programmes in both urban and industrial sectors in developing countries – among them Chile, Ecuador, Egypt, Indonesia and Tunisia.
- A recent example of a new mechanism is the Technology Information Centre, set up by the European Commission and the Confederation of Indian Industry. It will disseminate information to Indian industry on commercially proven and available indigenous and international ESTs, including suppliers.

In addition to these, and other bilateral programmes, there are also multilateral initiatives. One of the most successful of these has been the Multilateral Fund, set up under the Montreal Protocol on Substances that Deplete the Ozone Layer – itself a landmark agreement and a major international motivating force in the transfer of a specific category of ESTs to developing countries.

Montreal Protocol

Under the Montreal Protocol, the production and consumption of ozone depleting substances such as chlorofluorocarbons (CFCs), 1,1,1-trichloroethane, carbon tetrachloride, halons and methyl bromide are controlled, and will be phased out according to a schedule of strict time targets. Both developed and developing countries that are party to the protocol must abide by their respective phase-out dates, although developing countries are generally given a ten-year 'grace period' in which to comply. Additionally, the developing countries are provided with technical and financial assistance through the protocol's financial mechanism, and in particular its Multilateral Fund.



The transfer of cleaner technologies can help developing countries reduce and minimize their contribution to global environmental problems.

BOX 3.6*The OzonAction Programme*

Under the Multilateral Fund, UNEP has the specific responsibility for providing a clearinghouse function to help developing countries comply with the Montreal Protocol on Substances that Deplete the Ozone Layer. Since June 1991, UNEP Industry and Environment Centre's OzonAction Programme has been designing, developing and delivering quality-reviewed, need-based services for key stakeholders in developing countries.

Services provided by the OzonAction Programme include:

- information exchange to build awareness and assist with identifying, selecting and implementing alternative technologies and policies. It also helps in sourcing technologies, equipment and services;
- training at the regional level to build skills to implement phase-out activities;
- networking to provide government ODS Officers with a means of sharing their knowledge with their peers in developing and developed countries;
- country-specific support activities consisting of country programmes and institutional strengthening for countries that consume low volumes of ozone depleting substances, national training and refrigerant management plan preparation as specified in the country programme and approved by the Executive Committee.

OzonAction is an 'enabling' programme that strengthens the capacity of governments and industry in developing countries to take informed decisions that will result in effective investment projects. The goal of the programme is to build the local expertise required for the responsible management of phase-out projects with minimal external intervention.

Since the signing of the Montreal Protocol in 1987, there has been a rapid commercialization and adoption of literally hundreds of new technologies, equipment and chemicals. The impetus behind this rapid development of ESTs includes the new business opportunities offered by the shift to 'ozone friendly' technologies under the protocol, the supportive policies, incentives and disincentives put into place by governments, and public awareness and support for ozone layer protection.

The transfer of these newly commercialized 'ozone friendly' ESTs has been assisted by the four Implementing Agencies of the Multilateral Fund:

- the United Nations Development Programme (UNDP), which provides investment project design and implementation, demonstration projects, technical assistance, and country programme and institutional strengthening;
- UNEP, which provides a clearinghouse function consisting of information exchange, training and networking of ODS Officers (government officers in charge of proposing and coordinating strategies to reduce and phase out ozone depleting substances), and helps develop country programmes and institutional strengthening (see Box 3.6);
- UNIDO, which provides assistance with the formulation and implementation of small and medium-scale projects, technical assistance and training, and country programmes;
- the World Bank, which provides investment for project design and implementation, and country programmes.

As of late 1995, the Multilateral Fund had allocated nearly US\$0.55 billion to undertake over 1,300 activities – most of which involve the transfer of ESTs and the skills and knowledge required for their successful implementation in developing countries. These activities will ultimately phase out more than 65,000 tonnes of ozone depleting substances. To date, the completed investment projects have resulted in the elimination of about 1,500 tonnes of ozone depleting substances.

Ten years after the signing of the Montreal Protocol, the transfer of ESTs, supported by the Multilateral Fund, and independently by the private sector, has already resulted in measurable success: the atmospheric concentration of one of the major controlled substances – CFC-11 – is now declining. Since January 1994, industrialized countries have stopped the production of halons and, since

January 1996, they have ceased production of CFCs, carbon tetrachloride and methyl chloroform, except for some 10,000 tonnes a year for essential uses for which acceptable substitutes are not yet available. Although much work still remains, the undoubted success of the Montreal Protocol does prove that commitment and action by the global community to transfer ESTs and skills to developing countries can solve an environmental crisis.

Mixed private-public approaches

Joint implementation is an initiative involving government and the private sector: it is a controversial concept, but its advocates argue it could become a valuable mechanism for transferring ESTs to developing countries. Under joint implementation, countries can offset their greenhouse gas emissions by setting up reduction projects in other countries, and share 'credits' for the results. The idea is that a company in an OECD country will invest in projects in a non-OECD country, for example, an energy efficiency scheme in Asia, and then get a 'credit' for the resulting reduction in greenhouse gas emissions there. The basis of joint implementation is that emission reductions will benefit the environment no matter where they occur. A few examples of projects already under way are given below.

- A US\$200 million joint venture project has brought together a Canadian electricity utility, a state electricity board in India and the Asian Development Bank. Instead of building more coal-powered plants to meet India's growing energy needs, the Canadian company plans to upgrade current power distribution systems to produce electricity at half the cost and also sharply cut carbon dioxide emissions over the next 30 years.
- A French cement company has plans to modernize its cement plant in the Czech Republic. The project includes a 50 per cent

increase in production capacity, a 14 per cent decrease in fuel consumption and a complete upgrade of pollution control equipment.

- A deforestation project has been set up involving the Norwegian government, three Norwegian companies and Costa Rica. Between them, the companies and their government will invest more than US\$2 million. As a result, Norway will offset 200,000 tonnes of national carbon dioxide emissions over the next 20 years at much lower cost, says the government, than equivalent carbon dioxide reduction programmes at home.

With the World Business Council for Sustainable Development (WBCSD) taking the lead, industry groups strongly support joint implementation. The WBCSD says it will promote the development and expansion of new markets for innovative climate-friendly technologies, in particular, by providing a mechanism for companies in developing countries to acquire new ESTs. The WBCSD's International Business Action on Climate Change initiative attracted more than 80 proposals when it launched an international call for joint implementation proposals. They included renewable energy sources, methane emissions reduction, waste management and fuel conversion/switching, and represented a total potential for greenhouse gas reductions equivalent to the carbon produced by three 900-megawatt coal-fired power plants over a 20-year period.

In the United States, a voluntary programme designed by the Department of Energy and supported by more than 600 companies encourages individual power utilities to set their own carbon dioxide reduction goals. In addition, the companies have contributed US\$52 million to venture capital funds to be invested in fledgling enterprises around the world that promote alternative and renewable

TAKING SUSTAINABLE DEVELOPMENT TO HEART

Sustainable development has become a buzzword. But Petrotrin – the Petroleum Company of Trinidad and Tobago Ltd. – has taken the concept to heart by implementing a broad-based Environmental Management Programme to deal with critical issues like water quality, liquid and solid wastes, and education and training. Key elements include:

Manufacturing

A major US\$350 million refinery modernization project, nearing completion, includes technology-based pollution controls to reduce considerably emissions of liquid and gaseous pollutants. A new Sulphur Recovery Unit and the recommissioning of a mothballed gas oil Hydrotreater Unit as a mild hydrocracker, will virtually eliminate SO₂ emissions from our refining operations. Upgrading our Fluid Catalytic Cracking Unit (FCCU) will reduce carbon monoxide emissions and particulates.

We have eliminated two large oily sludge pits after biologically treating all contaminated material. We are also improving our wastewater treatment by removing storm water from our process water treatment facilities, installing closed bleed systems, and converting two barometric condensers to surface condensers to reduce the volume of contaminated process wastewater

needing treatment before discharge. Further, we are identifying, quantifying and mapping the dispersion characteristics of CO, NO_x, H₂S, SO₂ and particulate matter from the refinery, so that we can take measures in this area.

Exploration and Production

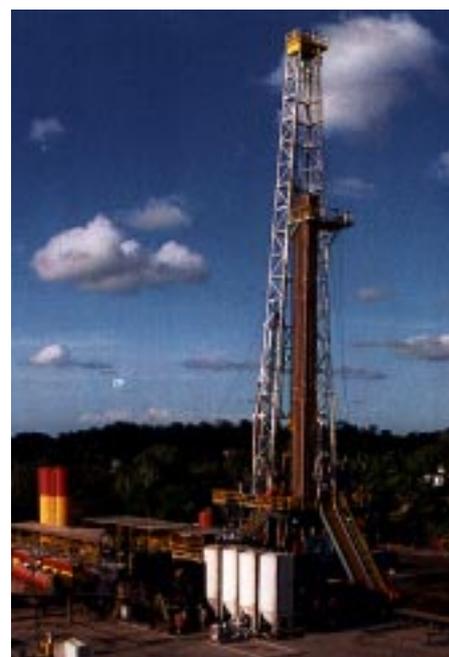
The country's petroleum industry has adversely affected the natural environment for many decades. We are addressing these problems by:

- * conducting environmental audits at our oilfields
- * upgrading oil and water separation facilities to reduce oil and grease in effluent
- * installing facilities for treating hydrogen sulphide gas
- * conducting a groundwater monitoring programme for a major fresh water aquifer to assess the effects on the aquifer of waterflood projects and current and past oil/chemical handling practices

Environmental Training

A broad cross-section of the company's employees are trained in environmental awareness and environmental management issues, including controlling chronic oil pollution at source.

Petrotrin is aware of its responsibilities as it explores for and produces crude oil and natural gas in the land and marine areas of Trinidad, participates in



Exploration drilling in Trinidad

upstream ventures with major international companies, and consolidates its position as the dominant supplier of petroleum products to the local market. We are committed to the highest environmental and health standards, within available funds. Our customers want reassurance that our products are produced according to modern standards of environmental management, and by a company which includes care for the environment in its daily operations. We can provide that assurance.



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energies. Also in the United States, a pilot programme, the United States Initiative on Joint Implementation, has the specific goal of encouraging private sector investment and innovation in the development and dissemination of technologies that reduce greenhouse gases.

However, environmental groups and many developing countries maintain a wary attitude towards joint implementation because they claim it lets developed countries off the hook in reducing their own greenhouse gas emissions. Joint implementation's supporters counter that while the industrialized economies produce most carbon dioxide emissions now, the situation will be reversed by 2010, so it is important to start tackling the problem immediately in developing and transitional countries.

The Framework Convention on Climate Change does allow a pilot joint implementation phase, which was due to end in 1997. The plan was that governments would then agree on how to carry out a proper joint implementation regime. But the WBCSD has already warned that the pilot phase is likely to fail because of lack of incentives to encourage investors in joint implementation projects.

Capacity-building

The OECD makes the point that to be effective, technology transfer or cooperation "should focus on strengthening the indigenous capacities" of local industries and companies. It says that governments at all levels, private sector organizations and aid agencies (bilateral and multilateral) need to incorporate pollution prevention approaches in their strategies and programmes. It also calls for more interaction and cooperation between these bodies.

Promoting exports

One other way of pushing technology transfer is to encourage the private sector in developed countries to transfer ESTs. The OECD has

BOX 3.7

Not one-time transactions

Environmentally sound technologies cannot be deployed effectively in developing countries simply by "movement of prepackaged technologies across national boundaries as one-time transactions", according to the World Resources Institute. The key, it says, is not technology transfer, but technology cooperation which "emphasizes the long term, prefers partnering to arms-length transactions, and implies joint concept and development of technology, innovations and adaptations in context that will benefit both parties over the long term".

The World Resources Institute says that governments, international organizations, aid agencies and non-governmental organizations should largely stay in the background, and "manage the preconditions which prompt individuals and enterprises to innovate in the right directions". It proposes the following key elements:

- enhancing environmental information disclosure – the sources, types, amounts and consequences of pollution in the developing countries;
- leveraging international standards to establish and enforce higher environmental management standards in the developing world;
- strengthening business charters for environmental technology cooperation;
- sector-specific intermediaries;
- building capacity for technology adaptation – reorienting existing aid programmes which still "rely too heavily on transfer of technology as a principal operating mechanism, focus too much on export promotion as a goal and too little on the development of internal capacity to adapt and renew technology of external origin".

called on member countries to make more use of export promotion programmes to achieve this, and several OECD governments have started to do so. For example, the Nordic Environmental Financing Company, a publicly supported venture, provides financing for firms from Nordic countries to export environmental technologies to Central and Eastern Europe.

The OECD has also proposed a package of other initiatives on export promotion:

- governments should keep better data on the volume and types of EST exports, so they

BOX 3.8*ESTs can overcome trade concerns*

The impact of domestic environmental standards on international trade has emerged as a major issue for business, particularly in developing countries. Here the fear is that stricter product standards in the developed countries may act as barriers to their exports and may be used as a form of disguised protectionism. This could force them to adapt processes or adopt new ones over and above domestic requirements.

However, the reality is that environmental concerns are becoming an increasingly important factor in international competitiveness in many sectors. Companies are going to be required to improve their processes and products if they want to compete, and firms in developing countries will be no exception.

The United Nations Commission on Trade and Development (UNCTAD) argues that the development and transfer of environmentally sound technologies (ESTs), in conjunction with the setting of domestic environmental standards, is the way for companies in developing countries to address the issue. ESTs, it says, "could both enhance trade and help preserve the environment by:

- making products originating from developing countries compatible with environmental standards abroad, thus improving trading opportunities and/or international competitiveness;
- improving the local environment of these countries; and
- arresting the deterioration of the 'global commons'."

UNCTAD points out that ESTs are different from other technologies because "the need to comply with standards is not merely defined by commercial interests, but also by an international consensus on protecting the environment. The difference between ESTs and other technologies rests on the need to link the transfer of ESTs to compliance with standards which are in turn linked to environmental concerns."

It acknowledges that lack of finance and capabilities, shortage of information and absence of domestic incentives are all restraints on transferring ESTs. But it argues that the supply of and demand for ESTs "are likely to be stimulated by policies that promote trade and growth in developed and developing countries alike – along with policies that contribute to more integrated developmental and environmental objectives. The implications of global and local environmental concerns for trade and technology, and the use of trade sanctions for enforcing standards show that firms in developing countries will need to embark on a drive for the development and transfer of ESTs." Otherwise, "limited access to ESTs could inhibit the ability of developing countries to implement new and stringent environmental standards and regulations domestically, and also exacerbate any negative effects of environmentally related trade restrictions imposed by developed countries".

can better identify those technologies not receiving export support;

- countries should conduct environmental reviews of their export credit and export promotion activities to check whether exports are beneficial or detrimental to importing countries' environments;
- governments should design their export promotion activities to ensure they complement the efforts of their aid programmes in fostering the transfer of ESTs.

Is trade a barrier?

One issue is whether trade policies and protection of intellectual property rights present a barrier to transferring ESTs or actually encourage the process. For example, import barriers in developed countries against products made with, or that contain, ozone depleting substances contribute to the adoption of 'ozone friendly' technologies in those countries.

The OECD studied seven ESTs: fluidized bed combustion; oxygen delignification in the pulp and paper industry; technologies to reduce or eliminate the use of chrome in the leather tanning industry; alternative cleaning processes to eliminate CFCs from the electronics industry; membrane cell technology in the chlor-alkali industry; ion exchange technology in the metal plating industry; and direct reduction technology in the iron and steel industry. All were developed in direct response to stringent regulatory requirements in an OECD country. The developers wanted to sell their technologies both inside and outside the OECD area. The study found that, generally speaking, trade policies were not a barrier to this. But two factors appeared as important obstacles to trade in ESTs.

- A key disincentive – cited by exporters and importers alike – was the lack of environmental requirements and/or enforcement in receiving countries. The main reason why industries in some countries imported ESTs was because new environmental standards

forced them to do so. Where environmental standards are inadequate or not enforced to create a demand for ESTs, trade in them will be hindered.

- The lack of access to financing was a further obstacle. Even when stronger environmental regulations required firms to obtain ESTs, they could not afford them. Companies lacked adequate cash flow to make a significant capital investment even when the ESTs offered lower operating costs and were more economical in the long term. This problem was most acute in Latin America and Central and Eastern Europe, and in countries with limited foreign exchange reserves. In some countries, governments seemed reluctant to strengthen or impose environmental standards because companies could not comply with them.

Based on the OECD study, exporters and importers would like governments to reduce or eliminate tariffs on ESTs, waive local content requirements or foreign exchange restrictions, and strengthen patent protection.

South-South transfers

A further dimension to the technology transfer issue is the question of South-South transfers to SMEs, especially in the least developed countries. Within the area of global warming and climate change, the regional networks of ODS Officers, run by UNEP under the Montreal Protocol's Multilateral Fund, have provided a successful platform for the exchange of policy and technology information between developing countries.

Technology for the People, a Geneva-based non-governmental organization, argues that a wide range of technologies tried and tested by firms in the more advanced developing countries – notably in Asia – could be transferred to companies in the least developed countries far more cheaply and effectively than transfers of more sophisticated technologies

from developed countries. The major obstacle is lack of money, and Technology for the People says that there is simply no official support, whether from home governments or international agencies. The other factor is that most of the more advanced developing countries have not yet adopted ESTs on a sufficiently broad scale themselves to be able to export them. In other words, they need to 'put their own house in order' first.

Addressing this issue at a UNIDO roundtable meeting in Vienna, Austria, in February 1995, experts pointed out that cooperation among developing countries could potentially reduce the costs of developing ESTs. One constraint is the limited range of technologies available in developing countries. The meeting proposed a four-point plan for governments and United Nations agencies:

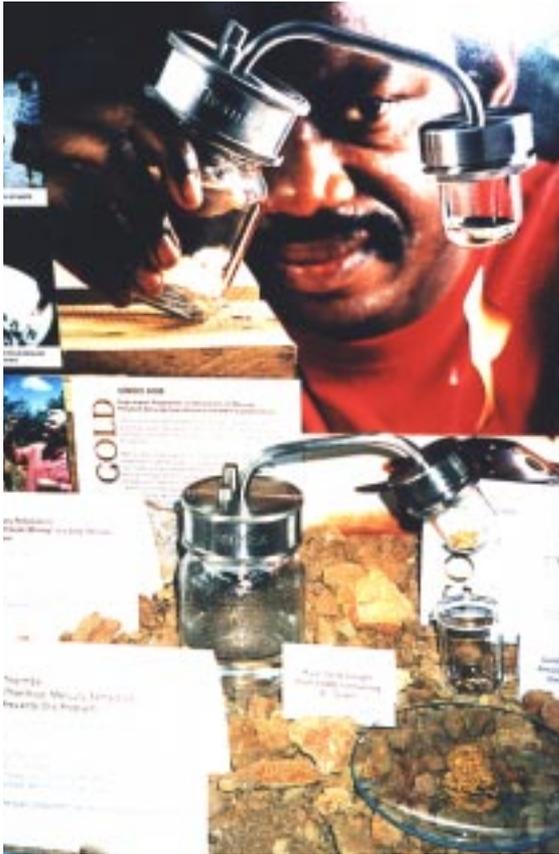
- joint research for problem solving "to assure that capacity-building measures are targeted to the frontiers of technologies, and to facilitate technology 'leapfrogging'";
- networking among research institutes in developing countries;
- regional centres that play a role in exchanging information and providing training programmes for capacity-building;
- networking with international organizations.

Developing countries themselves can of course do more to create a demand for ESTs by introducing and actively enforcing legislation, and through providing economic incentives. In addition, they could also develop national programmes for using ESTs to foster cleaner production and products: what an OECD workshop in Hanover, Germany, in 1994 called "a business plan for deploying ESTs where they would contribute most to preventing pollution and waste".

"Start at home"

One other interesting element in a successful technology cooperation strategy has been put forward by William A. Nitze, President of the

Stopping mercury emissions in small-scale gold mining



About 40 percent of the world's gold is extracted annually by small miners. Most of them use mercury to collect it. And that creates a major problem – because mercury is a serious and dangerous pollutant.

But for small miners, there is no alternative to using it. And with millions of people in Africa, South America, the Philippines, Indonesia and elsewhere supporting themselves through artisanal gold mining, mercury contamination and poisoning is a worrying issue in many parts of the world – and is becoming a global threat as it passes through the food chain.

mt metall-technic GmbH has developed the ThermEx closed system retort which prevents mercury emissions during small-scale gold mining.

It works like this. Gold is found in concentrations of 10-100 grams per ton in sand or stone, which is ground by hand into coarse gravel. The gold particles are so small, they are invisible. But they are large enough to be physically separated. Mercury is added to attract the gold and form a gold alloy. When this is heated over an open flame, the mercury vaporises, leaving the gold behind.

In open distillation, the vaporised mercury escapes into the atmosphere. But the ThermEx retort, weighing about one kilogram and the size of two cigarette packets, stops it from doing so by trapping it in a cooler tube, where it condenses before accumulating in a special collecting vessel.

Complete recovery of the mercury also eliminates losses of gold – because in open distillation, the mercury vapour carries up to 0.5 percent of the gold into the atmosphere. Gold losses in open distillation total up to 5 percent of the processed gold content. That means many tons of gold are wasted.

ThermEx was described as a “new dimension in retorts” at the Expert Group Meeting on UNIDO's High Impact Programme for the Abatement of Global Mercury Pollution Deriving from Artisanal Gold Mining – and was also presented during the UN General Assembly Special Session (Rio + 5) in June 1997.

The world needs gold, and millions depend on artisanal gold mining for their livelihood. Now, thanks to ThermEx, both needs can be met – without endangering the health and lives of millions from one of the deadliest pollutants on earth.

mt
metall-technic



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Alliance to Save Energy in the United States – “start at home”. He points out that many OECD countries face a challenge in extending the use of ESTs internally similar to the one faced by developing and Eastern European countries whose governments “have almost as much work to do in organizing for change” as elsewhere.

“The United States and other OECD countries will have little credibility in helping developing or Eastern European countries

deploy ESTs and methods if we are unwilling or unable to adopt them at home ... If OECD companies do not develop and implement extensive ‘eco-efficiency’ programmes and extend them to their overseas affiliates, companies in non-OECD countries are unlikely to make the necessary changes in their own management procedures. We must act as laboratories in discovering what does and does not work.”

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