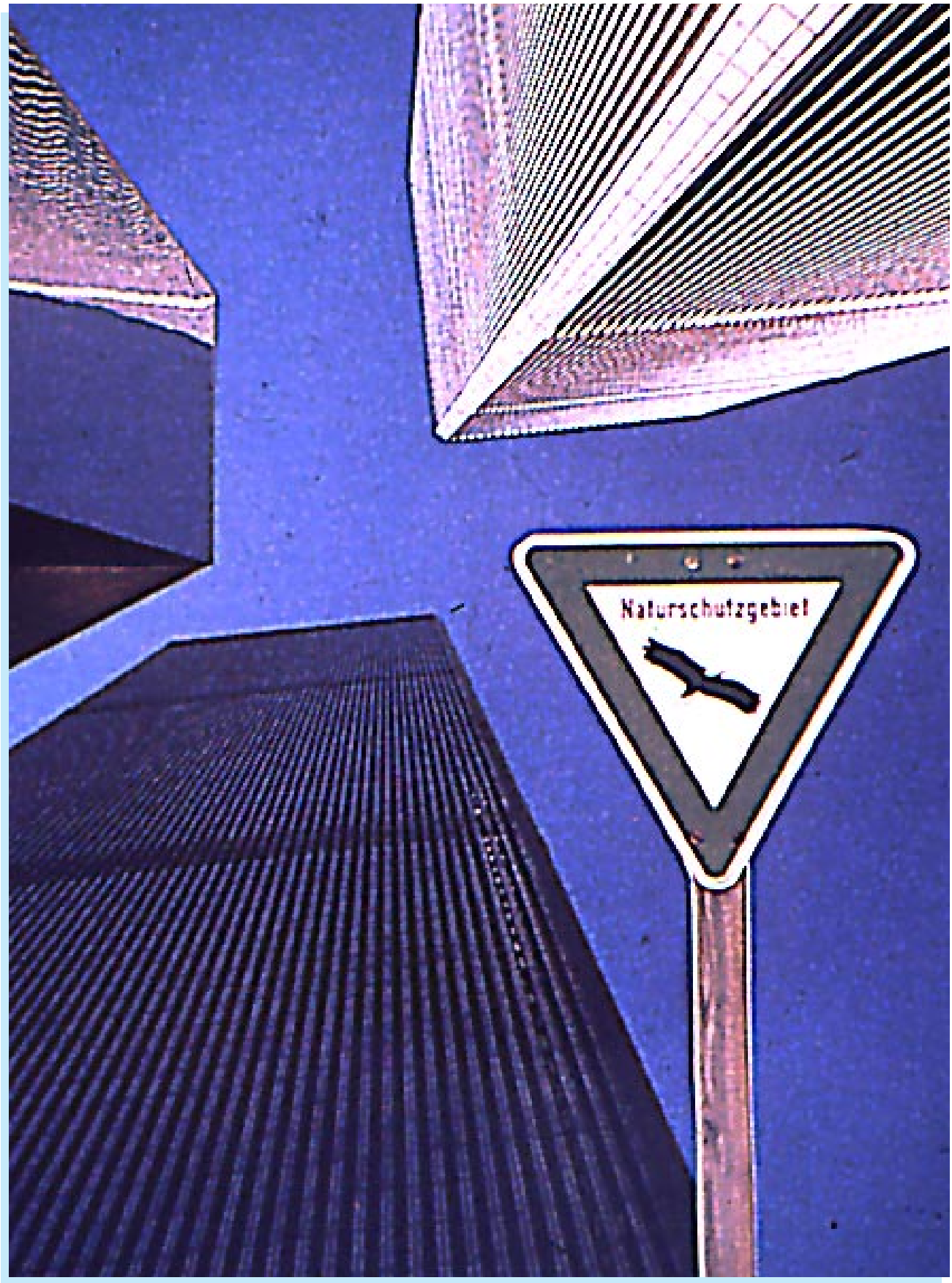

Environmental technology assessment (EnTA) is a tool that helps decision makers anticipate the environmental consequences of technological developments.

Environmental technology assessment 13

Introducing environmentally sound technologies (ESTs) – whether creating new solutions for industries in developed countries, or transferring technologies to developing countries – should bring opportunities. But it can create risks too. The key to avoiding these is to understand the impacts the new technologies may have, and to explore alternatives before making significant investments. Environmental technology assessment is an important tool to help decision makers make informed choices.

The real value of environmental technology assessment (EnTA) is that it places environmentally sound technologies (ESTs) in a broader context by providing decision makers with an objective analysis of the positive and negative effects of the introduction or use of a technology on the environment and society. It can be applied at the micro- or macro-level and involves multiple stakeholder perspectives.

At the micro-level, EnTA is applied to a specific technology (for example, cyanide extraction in gold mining) to indicate environmental impacts and possible alternative technologies. At the macro-level, technology is not defined as a piece of equipment or a single process, but rather as a production system such as car manufacturing or mining. EnTA's strength as an assessment tool is that it allows decision makers to anticipate the environmental consequences of various technologies and make decisions in line with a country's policies.

UNEP's Environmental Technology Assessment Programme aims to create awareness of the need and value of EnTA among the key decision makers, such as government agencies, industries and trade associations, technology suppliers and developers, non-governmental organizations, research institutions and funding organizations, and to encourage its use as a policy tool. It sees EnTA as an important element "to support the development and application of ESTs". The main objective of the programme is to stress the importance of including environmental considerations in technology assessment. The programme gives priority to developing countries, and embraces a number of elements within its two core activity areas of awareness-raising and capacity-building.

In awareness-raising, the focus is on using existing demonstration projects and case studies in developing countries as reference points, with the aim of:

- showing the linkages between economic and environmental benefits; and
- illustrating both good and bad technology choices from an environmental standpoint.

The objective of capacity-building is to build capacity for carrying out and applying environmental technology assessments, by providing:

- information on EnTA methodologies and the data needed to apply them; and
- directories of technology assessment institutions and sources of information and training resources.

UNEP's *Anticipating the Environmental Effects of Technology* is a two-part document containing a primer and workbook to be used by people in government and other areas. It is designed to help the user be "more aware of, sensitive to and able to act on potentially adverse effects of new technology". New

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technology here includes new or adapted technologies that are introduced to a country or location. *Anticipating the Environmental Effects of Technology* lists ten steps for conducting a technology assessment.

Ten steps for EnTA

- *Examine the reason for the proposed technology*. This is key to anticipating both the beneficial and any possible undesirable side effects, and to understanding what the alternatives may be.
- *Describe the technology*. This should include material and energy inputs, capital and labour inputs, industrial and engineering processes and operations, products and by-products, scale of operation and transportation requirements, as well as when the technology will be deployed, what significant modifications or improvements it will involve and when, and how fast, it will replace older technologies.
- *Consider alternatives*. These include possible systems modifications or other approaches to dealing with the reason for introducing the proposed new technology.
- *Examine future trends and events*. How will future trends and developments, including local ones, affect the technology, and what impact may it have on them?
- *Identify affected stakeholders*. Individuals, organizations and institutions that may be affected by a particular technology or, conversely, how they can influence it. It is important to know who they are and their likely role.
- *Identify and evaluate potential impacts*. Direct impacts are those which arise from the technology itself, its product or output, and its uses. They can include intended or designed benefits such as improved energy efficiency. It is equally important to assess and evaluate indirect or secondary costs and benefits. The most significant environmental impacts are likely to be on labour, land, energy, minerals and the environment itself.

BOX 13.1

Suppliers' claims felt unreliable

Three in four of the key decision makers involved in choosing environmentally sound technologies (ESTs) would not rely exclusively on the suppliers' assessment of the environmental impact of their technologies. This finding emerged from a survey by UNEP's International Environmental Technology Centre (IETC) into the training needs for improving decision-making in managing ESTs for large cities and freshwater lake and reservoir basins. Questionnaires were sent to 1,500 experts, and 520 replied.

Asked if they would rely exclusively on the environmental impact assessment of ESTs by the suppliers, 38 per cent said 'No' and another 36 per cent said they would only do so after consulting other users. Only 8 per cent found suppliers' environmental technology assessment (EnTA) reports reliable.

Central government institutions and scientific bodies carry out most EnTAs; independent research centres, local or municipal government institutions, and the private sector carry out rather fewer. The survey respondents rated central government as the main decision maker, followed by local or municipal governments, environmental specialists, industrial managers and non-governmental organizations. Half stated that technology decisions were "very much" or "to a large extent" based on scientific EnTAs which IETC called "somewhat discouraging".

What should decision makers know about environmental implications of technologies before deciding on their use? The replies included:

- they should be knowledgeable about the environment and EnTA;
- they should be aware of, or familiar with, various countermeasures and methods for solving environmental problems;
- information on how the technologies in question fared in other countries is a crucial part of the decision-making process;
- alternative technologies should be evaluated to ensure the most appropriate one is employed;
- decision makers must be knowledgeable about waste management, risks, energy usage and the cost benefits of the ESTs under consideration;
- the ability to detect fault information in technical reports, and to anticipate potential effects of ESTs is imperative;
- decision makers need to be familiar with pertinent general information on the ESTs in question and local conditions.

The longest journey begins with a single step

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NEEDS TO BE SERVED, A RESPONSIBILITY TO BE MET

Hydro's business activities span a wide range of industries satisfying the basic needs of a modern society – light metals and polymers indispensable in transportation, construction and manufacturing, oil and gas as valuable energy and feedstocks for diverse activities.

Every one of our enterprises brings benefits to society – and also brings new challenges in environmental responsibility.

Hydro has been engaged in systematic environmental management and continuous technical improvement for over 30 years:

- first installing equipment to reduce discharges from existing plants
- developing and introducing cleaner technologies, improving energy efficiencies, implementing modern process surveillance, raising the quality of routines, competence and standards, and
- now, focusing on sustainable production by initiating life cycle studies in all our business areas to produce more from less, and satisfy increasing needs, while imposing less demands on valuable resources.

Since 1993, our environmental aims have been anchored in Hydro's strategic principles:
OUR PRODUCTS should place minimum demand on the environment over their life cycle, and recycling and reuse are a part of this strategy.
OUR PRODUCTION TECHNOLOGIES should use energy and resources efficiently. We place the same stringent demands on suppliers.
OUR RESEARCH AND DEVELOPMENT should contribute directly to developing appropriate solutions with a long-term environmental perspective.
OUR EXTERNAL RELATIONS should demonstrate candour and openness.
OUR ORGANIZATION will be characterized by a high level of environmental consciousness at every level. Managers will share the responsibility for applying these principles in their planning and actions.

WE HAVE MADE A BEGINNING, BUT MUCH REMAINS TO BE DONE

The pace of global development sets us a continuous challenge. We have set out on a journey towards the goal of environmentally responsible development. It is a long journey, but we have taken the first important steps.

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HYDRO

BOX 13.2

Using EnTA to choose the right technology in India

One example of a way environmental technology assessment (EnTA) can be used is illustrated by the approach taken to consider and choose wastewater treatment alternatives for Munger and Bhagalpur in India.

Conventional wastewater treatment plants can be expensive to build and require exacting operation and maintenance programmes. Moreover, in a tropical climate like India's, treatment systems based on slow trickling filtration processes run into problems of smell and attracting insects. This makes it especially important to rank the technology options that will achieve the desired level of treatment, while taking into account other key factors such as the availability of land, equipment, energy, skilled people, and costs and benefits.

In most countries, municipal wastewater is treated in several stages: preliminary treatment (screening, removing grit and so on); primary treatment (mixing, flocculation, sedimentation, flotation and filtration); secondary treatment (activated sludge or trickling filtration, then secondary sedimentation); and tertiary treatment (anaerobic or aerobic digestion, and disposal of mineralized sludge). In India, however, a number of alternative low-cost wastewater treatment options are applied, including waste stabilization ponds, aerated lagoons, oxidation ditches and carousel ditches.

The usual way of measuring the effectiveness of these systems is according to how much they reduce biological oxygen demand, suspended solids and total coliforms. On that basis, waste stabilization ponds are the most commonly used method of sewage treatment in India, because they treat effluent to a higher final quality than the others, and are also reliable and easy to operate although they use more land.

Applying a different methodology for assessing the technologies produces a different result. The assessment sequence is:

- identify the alternative treatment processes to meet the stipulated effluent standards;
- estimate the sizes of individual units in the treatment process;
- estimate land, power and staff requirements;
- estimate annual benefits and net annualized costs, if any;
- identify the attributes for ranking and assign scores to individual processes;
- add up the scores for individual alternatives and draw up a ranking list.

The costs of various treatments were estimated based on capital costs of the works, cost of land, and operating and maintenance costs. The capital costs were annualized to obtain a common basis for comparison and, where applicable, sales of biogas, sludge and treated wastewater were added in. Energy and staff costs were also included. Three parameters were used: environmental (reduction of biological oxygen demand in the effluent); health (percentage destruction of coliforms, helminths and viruses); and aesthetic (odour, suspended solids and fly nuisance). Based on these criteria, the ranking of the various ESTs was as follows (from the top):

- aerated lagoon;
- aerated lagoon with settling pond;
- carousel oxidation ditch;
- activated sludge process;
- stabilization ponds;
- trickling filter bed.

- *Identify the key decision makers*. Deciding who has authority to act or influence technology is not necessarily straightforward. It can be government, the private sector, corporate or non-business groups, or any combination of these. Therefore, identifying who has rights and authority is important.
- *Identify action options for the framework that supports decision-making*. For example, government actions can include regulations, permits, and incentives or disincentives – all of which can be powerful instruments for shaping choices.
- *Draw conclusions*.
- *Make recommendations*.

Following a successful EnTA

Following a successful EnTA, a company (or government) may:

- modify the project to reduce disadvantages and/or increase benefits;
- identify regulatory or other control needs;
- define a surveillance programme for the technology as it becomes operational;
- stimulate research and development to define risks more reliably, forestall anticipated negative effects, identify alternative methods

A Philosophy of Continuous Environmental Improvement

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But we all have to contribute, including business – and as a multinational company supplying the manufacturing industry with basic chemicals and intermediates, and the agricultural sector with chemical fertilizer products, we are certainly aware of our responsibilities.

That is why environmental protection is an integral part of our continuous improvement policy. Why we

- take environmental demands into account in conducting our business activities
- encourage and promote awareness of environmental issues throughout our organization – and the significance of our activities to the environment
- aim for continuous efficiency improvements in the use of energy and raw materials
- work for the systematic reduction of air and water emissions
- involve our suppliers and customers in the search for environmental improvements
- take advantage of cleaner technologies
- adopt ISO 14000 and Responsible Care as models for effective environmental management

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BOX 13.3

Assessing environmentally sound technologies in India

The Technology Information, Forecasting and Assessment Council (TIFAC) was set up by the Indian government with the brief to study future environmentally sound technology (EST) choices for addressing the country's environmental issues. While TIFAC did not use EnTA methodology *per se* in its work, its method of assessing future ESTs mimics the EnTA concept.

Fly ash

Fly ash, a waste from thermal power plants, causes serious pollution problems. Fly ash utilization is high in industrialized countries (80 per cent in Germany, 70 per cent in the Netherlands and 65 per cent in Denmark, France and Belgium) but extremely low (2 per cent) in India. India's experience with imported technologies has not been satisfactory because of factors such as variation in the quality of fly ash, plant and equipment engineering.

TIFAC's studies focused on more effective ways to use and dispose of the 30 million tonnes of fly ash produced every year, and concluded that among the possible applications were underground mine fills, building components, roads and embankments, ash ponds, and dams and hydraulic structures. The government subsequently launched a programme to develop technologies for fly ash utilization involving three ministries and user and industry groups, who will part-fund the activities, including large-scale demonstration projects.

Leather

Leather, one of India's traditional industries, has enjoyed phenomenal growth in the past ten years and become a major export earner. However, the leather tanning industry is one of the most polluting. TIFAC's study identified the need for both technology upgrading and new technologies, including ESTs, such as the use of enzymes for dehairing, end-of-pipe effluent treatment and waste management (for example, chrome recovery from effluent).

Industry is now participating in a programme which focuses on ESTs including enzymatic dehairing, chrome management and upflow anaerobic sludge blanket bioreactors, as well as less-salt and saltless curing methods, new vegetable tanning methods and solid waste reduction through process changes.

Energy

TIFAC has identified energy as a priority area, and called for the development of technologies aimed at achieving energy conservation and the development of new renewable energy sources. Coal will continue to be a major source of energy in India, but Indian coals have a low sulphur content and so the quality is inferior. Whereas most research and development efforts in other countries aim at reducing the sulphur content of coal, TIFAC's study shows that the technology need in India is for coal gasification.

Sugar

India is the world's leading raw sugar producer, but the recovery systems in most factories are far less efficient than in other countries. TIFAC has recommended the development of membrane technology, along with biomethanation for treating effluent. Its proposals have been incorporated in a new programme on sugar production technologies set up by the government.

TIFAC has also established a series of task forces for long-term technology assessment in areas such as food processing, road transportation, packaging and biotechnology.

for achieving technology goals, identify corrective measures for reducing or eliminating negative effects;

- identify experiments in order to clarify uncertainties;
- identify needed institutional changes;
- identify new benefits;
- delay the project;
- identify partial or incremental implementation strategies;
- prevent the technology from developing or being used.

A systems approach

The UNEP primer draws a clear distinction between environmental assessment and EnTA. The former is a public policy tool, widely used worldwide, invariably required by regulation, and focusing mostly on air, water and land, whereas an EnTA adopts a "comprehensive systems view", taking a far broader look at all the effects of the technology, and considers the alternatives. UNEP stresses the importance of not thinking too narrowly about the technology but instead adopting a systems approach with particular

> We need to enable the developing countries to make a great leap towards eco-efficient production … What the industrialized countries can do is offer their experience and transfer their environmentally sound technologies
>
> Thorbjorn Jagland, Prime Minister of Norway

> Solutions require vision, innovation and leadership. The private sector has all the essential credentials to actualize the goals of sustainable development. With its eco-efficient leadership, it can steer us to a sustainable future
>
> Syeda Abida Hussain, Federal Minister for Environment, Pakistan

> Sustainable development is not something governments or international bodies do to people. [It] is something people do for themselves, and for their children
>
> Cielito F. Habito, Secretary of Socio-Economic Planning, the Philippines

> All countries of this world are in the same boat. If it floats, all will survive. Should it sink, all will perish – be they developed or developing countries, rich or poor nations
>
> Ali Bin Said Al Khayareen, Minister of Municipal Affairs and Agriculture, Qatar

emphasis on "the exploration of the total technology cycle from concept to disposal". "One must look over the whole cycle, which may run anywhere from months to 50 or more years, to understand the system fully."

Decision makers "should not limit their thinking to the technology that has been proposed, but appreciate there are always competing technologies. Also, there are nearly always emerging technologies which may hold promise of doing the job or reaching the objective in a better way. In many cases, there are non-technological alternatives to achieving the objective at hand – institutional, legal, or regulatory alternatives which are sometimes called social technologies."

All technologies go through the same generic cycle: identify the need, problem or opportunity; the choice of alternatives; selection of sites and technologies; design; construction, operation and maintenance; and repair follow-up. "A cursory examination of the cycle shows it is replete with assumptions about the short- and long-range future", says the UNEP primer. "The short-term assumptions about pay-out and effects often mask deep-seated uncertainty

about the longer-range future, and the potential for previously unexamined negative or positive outcomes." This underlines the need to carry out a thorough, wide-ranging EnTA.

Growing interest and cooperation

There is growing interest in technology assessment in Europe – and an increasing focus on the environmental impacts of technologies. However, the picture is very uneven: a survey by the Institute for Technology Assessment and Applied Systems Analysis, in Karlsruhe, Germany, found (unsurprisingly perhaps) that Germany was the most active country in the field, with over half the current EnTA projects. It was followed by the United Kingdom, Switzerland, Denmark and Austria.

The survey found that "problem-induced" EnTAs had replaced the "classical technology-induced" technology assessment investigations, which examine the environmental impacts of specific individual technologies. This, it said, reflected the goal of developing options "for environment-friendly solution of social problems, which generally include not only technological approaches but also social innovation". However, many of the EnTA projects also focused on how to accelerate the diffusion of ESTs, concentrating mainly on policy measures, and providing more financial and other support for firms. The emphasis on problem-induced assessments "is possible acknowledgement that technology-induced technology assessment falls short of its goals in many cases since alternatives to the technologies under review and interdependencies between technologies are given too little attention, and the demand for individual technologies is frequently not questioned".

In 1995, the European Commission set up a European Technology Assessment Network and also made funds available for a specific programme on targeted socio-economic research. More than a third of these funds will be for technology assessment.

The United Nations Commission on Sustainable Development has underscored the importance of finding out developing countries' needs for ESTs in the context of technology cooperation. Some initiatives include:

- a European Commission-funded project to help Tunisia identify its requirements, select suitable technologies and determine their appropriateness;
- a national needs assessment in Costa Rica, supported by the Netherlands;
- a joint Switzerland-Pakistan project to identify the demand for ESTs in Pakistan's textile and paper industries, enhance the capabilities of these industries for absorbing the technologies, and promote partnerships between Swiss suppliers and potential users in Pakistan.

"Fix it or scrap it now"

Over time, as decision makers in government, industry and other areas focus more on introducing ESTs into their policies and practices for managing environmental issues, EnTA will assume increasing importance as a key methodology for assessing all the factors involved in technology choices. To quote the UNEP primer's "elementary guideline", the question comes down to: "Will this project, plan or programme be good for our children, and our children's children? If not, fix it or scrap it now."

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