Environmentally Sound Technology Performance Assessment (ESTPA) – A Guide for Decision-makers

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A major concern in many countries is the increasing use of unproven technologies by organizations and individuals to address environmental problems. Consequently, national governments and other national and international organizations have argued that a mechanism to evaluate candidate environmentally sound technologies is urgently required. One option for augmenting the capacity of decision-makers to make informed decisions is the application of Environmentally Sound Technology Performance Assessment (ESTPA) as a technology screening and assessment tool. ESTPA is particularly relevant to developing countries in facilitating:

- The evaluation of performance claims for environmentally sound technologies, both proposed or currently being utilised.
- The establishment of an institutional mechanism, geared to the needs of developing countries, by which the environmental performance of technologies can be evaluated (i.e., ESTPA can be used by local agencies to establish a technical and social oversight process for evaluating technological options related to environmental quality improvements).
- The building of capacity within scientific organizations through the provision of technical assistance, quality assurance/quality control (QA/QC) protocols, and other technical advice which can help developing countries establish the capability to independently assess proposed technology options (i.e., ESTPA can support the efforts of government agencies and scientific bodies ultimately responsible for assessing the environmental performance of technologies).
- Linkages with international organizations that can provide and technical advice in support of the adoption and use of environmentally sound technologies (ESTs).

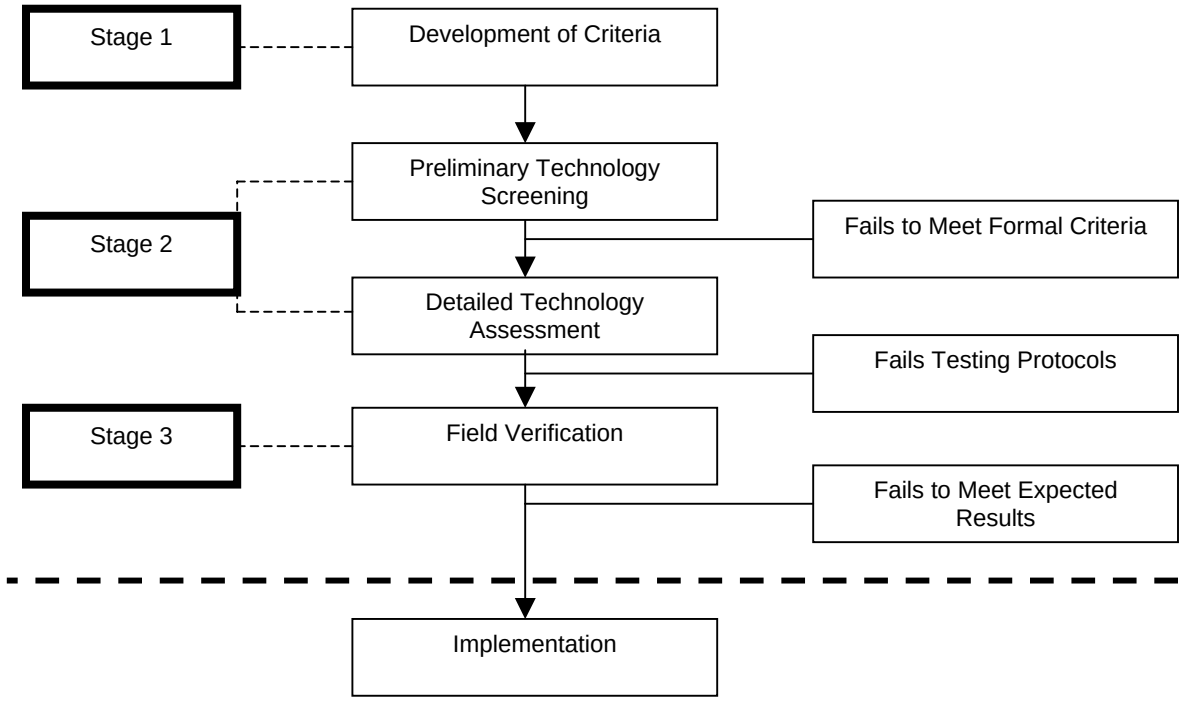
Description of the Environmentally Sound Technology Performance Assessment Process (ESTPA)

The purpose of the Environmentally Sound Technology Performance Assessment process is to help evaluate the appropriateness and applicability of technologies using a comprehensive technology assessment and verification protocol. The ESTPA process can be used by local government and private sector organizations to perform technology assessment and verification leading to the identification and selection of appropriate environmentally sound technologies. Through ESTPA, and in collaboration with national governments, international agencies and NGOs, UNEP/IETC is seeking to establish a comprehensive technology assessment procedure for reviewing potential environmentally sound technologies.

As shown in Figure 1, the entire ESTPA process consists of three stages: Stage 1 – Criteria Development; Stage 2 – Detailed Assessment; Stage 3 – Field Verification. ESTPA facilitates the assessment and evaluation of proposed environmentally sound technologies based upon internationally recognised technical protocols incorporating sound science and statistical analysis. The process can also be structured to take into account social and economic parameters specific to the needs of developing countries. In most cases, the ESTPA process endeavours to utilise local laboratory facilities and technology institutions for the provision of technical and

organisational oversight. In addition, institutional capacity building and related training through the ESTPA process can be instrumental in strengthening local technology infrastructure.

Figure 1: The ESTPA Process



The goal of ESTPA is to identify suitable environmentally sound technologies through comprehensive assessment based upon established criteria and recognised technical protocols. In meeting the basic objectives of the ESTPA process, the following activities are undertaken:

- Development of detailed criteria for screening, assessing and verifying environmentally sound technologies.
- Development of testing protocols based on established criteria in order to validate the performance of technologies and identify possible changes that may enhance a given technology where appropriate.
- Organization of independent third party verification of technology performance against established testing protocols.

UNEP/IETC recognises that different technologies may be at various stages of screening, assessment or field verification. The ESTPA process typically involves collaboration at the national government level in the following areas:

- **Implementation of a controlled pathway through which environmentally sound technology applications are processed.** The government entity responsible for assessing candidate technologies would receive proposed technologies from proponents. All technologies submitted for screening would be required to provide fundamental physical, chemical and cost information. Technologies brought forward without the necessary documentation would be “screened out” and not accepted until the requisite baseline information is made available.

- **Establishment of a team of technical specialists to screen proposed technologies based upon accepted criteria.** Members of this team would come from government and qualified representatives from academia, international agencies and local NGOs. The team would assess technologies based upon established criteria.

- **Organisation of an independent third party assessment**. After the initial screening, candidate technologies would undergo assessment by an independent third party, unless the necessary technical information generated by an independent and reputable testing agency is already available and can be provided. The ESTPA process also provides support, if necessary, in outlining the preferred protocols for independent laboratories or testing agencies in performing the assessment , as well as facilitating the testing of technologies under conditions of expected use.

- **Facilitation of linkages with international agencies, other national governments and local organizations.** This is important in helping to establish the capacity to develop country-specific ESTPA programmes.

For technology proponents, the ESTPA process can help determine actual operational parameters and identify strengths and weaknesses of candidate technologies under field conditions. Furthermore, successful completion of a detailed laboratory assessment could in some cases lead to verification as part of an internationally recognised performance verification process.

ESTPA Stage 1 - Criteria Development

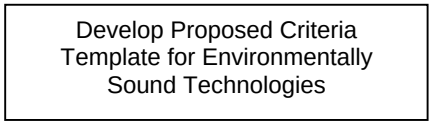
Establishment of detailed criteria for evaluating proposed environmentally sound technologies is the first step in the ESTPA process (Figure 2). This is done in association with key government agencies, international agencies, academic institutions and NGOs.

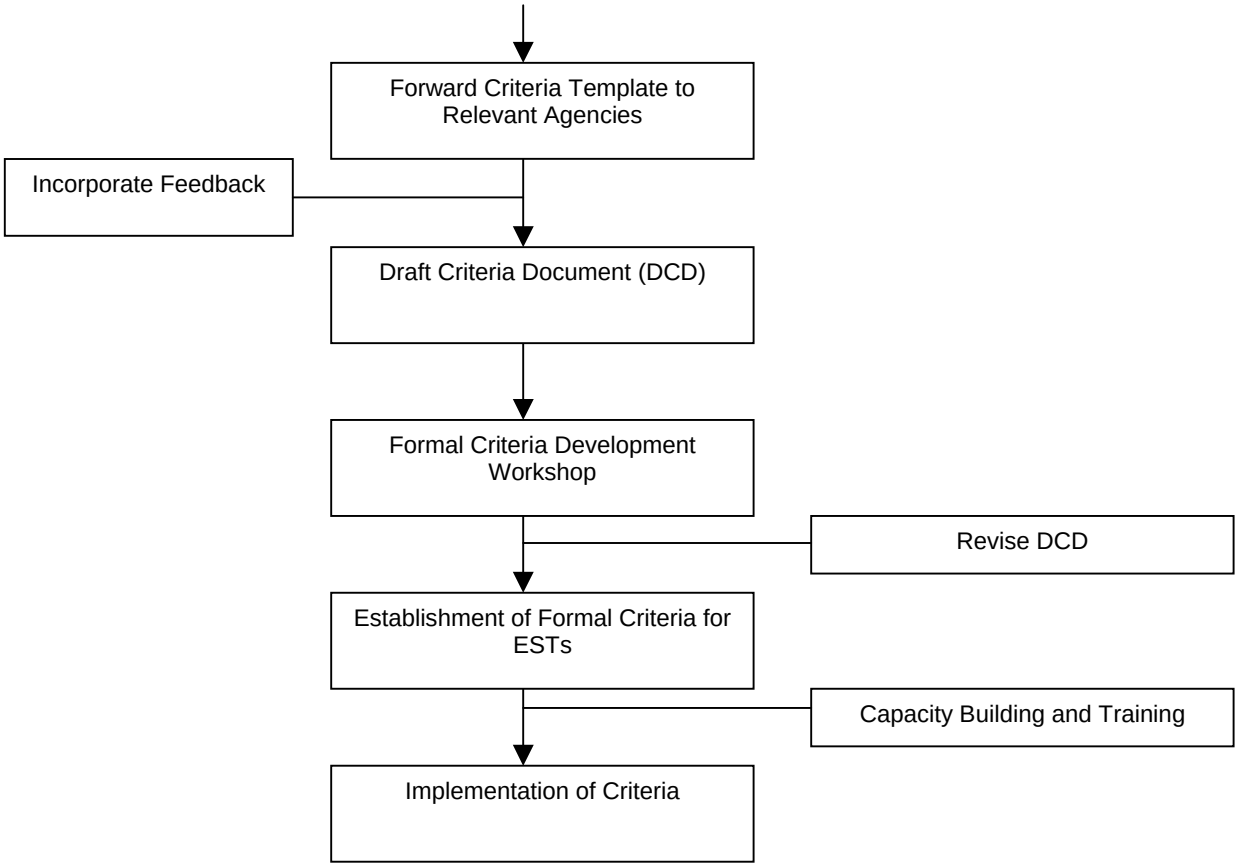
Stage 1 starts with a review and consolidation of current experience with respect to multi-stakeholder consensus building in relation to the development of environmental and other criteria. A similar process is undertaken in relation to various technology assessment and verification methodologies and protocols. The results are provided to government organizations and other stakeholders for consideration and comment, and their feedback is incorporated into a Draft Criteria Document (DCD).

The DCD is then discussed in an intensive two-day workshop and a final set of criteria for screening, assessing and verifying environmentally sound technologies, agreed to by stakeholders, emerges.

The criteria for assessing and verifying environmentally sound technologies would not be limited to technical parameters, but would include a broader range of “soft” parameters (i.e., social, cultural, economic and other criteria) that may impact local user acceptability. All of the criteria under review would ultimately have to be weighted against the fiscal realities of the potential users to ensure that the technology can be implemented and sustained. Thus both quantitative and qualitative parameters are applied.

Figure 2: ESTPA Stage I – Development of Formal Criteria for ESTs





Quantitative parameters would include, but not be restricted to, the following:

- **Engineering Parameters** (i.e., optimal size, flow dynamics, capacity per unit volume, durability, incorporation of technology into the existing system, ease of use, cost, ability to incorporate secondary contamination treatment technologies, etc.)
- **Other Parameters** (i.e., removal efficiency, treatment, any chemicals required, kinetics, chemical regeneration and/or disposal of saturated media if applicable, ease of use, cost, etc.).

Qualitative parameters are not as readily defined. Constraints for a given technology which may impact a particular group in one country may have little, if any, impact on a similar group in another country because of differing social, cultural or regional circumstances. Nevertheless, it is expected that qualitative parameters would include the following:

- **Social Parameters** (i.e., geographical location, technical support if necessary, delivery mechanisms, education restrictions, cultural restrictions, sustainability, cost, etc.)
- **Fiscal Parameters** (i.e., regional income, financial assistance if necessary, cost, sustainability, etc.).

Beyond the criteria of effectiveness and acceptability, the application of ESTPA is intended to take into account the capacity of the governments in developing countries in terms of the

manufacturing, distribution and servicing requirements of any technology for implementation. Parameters to be examined in this regard include: manufacturing base, distribution base, servicing, information dissemination, training and development, regulatory requirements, etc.

Technologies that can be adapted to be "made in developing countries" clearly have a greater potential for smoother implementation and sustainability. In some cases, significant investment may be required to successfully implement potential technologies. However, this in turn could lead to revenues accruing to local institutions and organizations from manufacturing and dissemination of the technology(ies).

ESTPA Stage 2 – Detailed Assessment

Technology Screening

Following development of the criteria to be used for screening, assessing and verifying potential environmentally sound technologies, the ESTPA process can be used by the local government to perform a detailed screening of technologies (Figure 3). Due to the demands on time, equipment and the high cost of laboratory assessment and verification of technologies, not all technologies that meet the established criteria would move forward through the process. Thus the number of technologies actually submitted for laboratory testing and verification would be limited.

Three categories of technologies are likely to be considered through the ESTPA process:

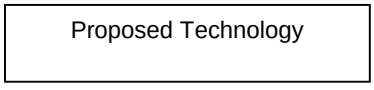
- **Technologies currently being field tested by governments** – ESTPA could perform initial screening on those technologies currently being field tested. A joint ESTPA/government committee would review the technologies that meet the criteria. The decision regarding which technologies are to continue through for laboratory assessment and/or verification would be determined by the joint committee, based upon the results of the screening process.

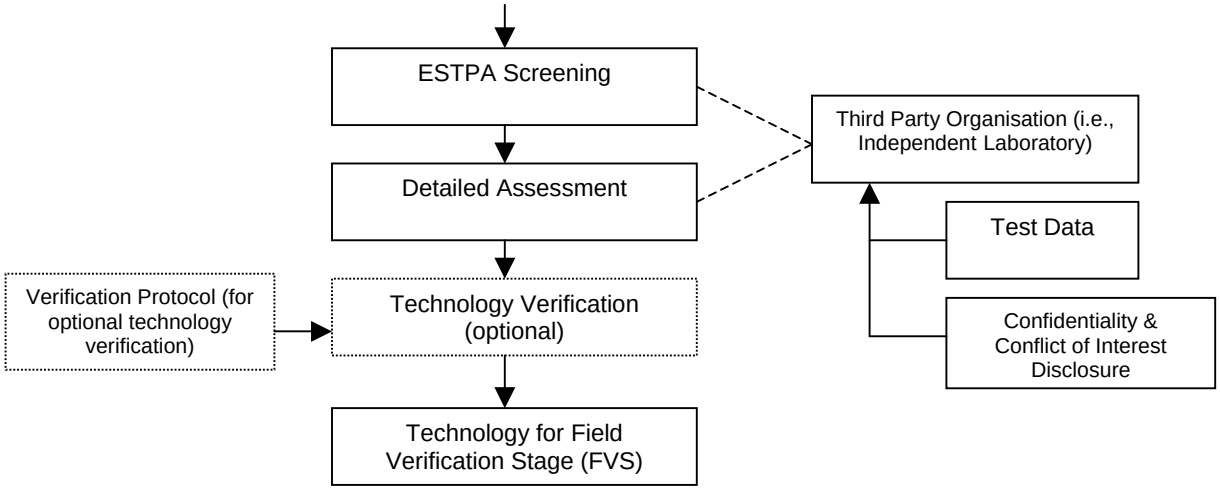
- **Technologies brought forward by established institutions** – A second category of technologies targeted for screening would be those applications brought forth by established organizations. The technologies within this group may have already been subjected to detailed independent assessment by a recognised institution or organization. It is important to note however, that technologies assessed by the same organisation under the supervision of the immediate proponent would not be considered valid.

- **Technologies brought forward by the private sector** – The final category of technologies to be screened by the ESTPA process would consist of technologies put forward by private sector proponents. Recognising that some technology proponents within this group may lack the required resources to perform adequate independent assessments, the joint ESTPA/government committee would play a role in reviewing the technologies that successfully meet the criteria and identifying the best candidate technologies for independent laboratory assessment.

Results of the screening of a given technology would be made available to the proponent of the technology. It is also understood that the proponents of a given technology that meets the criteria would have to assume the cost of the verification process.

Figure 3: ESTPA Stage 2 – Detailed EST Assessment





Laboratory Assessment

Technologies that successfully pass through the screening process but lack independent laboratory assessment with respect to physical, chemical and operational parameters require further consideration under the ESTPA process. For these technologies, an independent laboratory assessment would be performed involving the collection and analysis of data on selected candidate technologies under simulated conditions of operation. Qualitative, physical and chemical parameters would be monitored to determine the efficacy of the candidate technology. Similarly, operational costs would be monitored to determine the accuracy of financial projections. Technologies that fail to meet the agreed upon performance criteria would not be qualified under the ESTPA process.

Technology Verification (Optional)

Selected technologies that successfully demonstrate the claims of their proponents and meet the established criteria can be verified by an independent third party organisation as part of the ESTPA process. Under this optional arrangement, a verification certificate could be awarded upon successful verification of the technology. This can be done as part of a regulatory programme or to clarify performance relative to other technologies in the marketplace.

Technology Fact Sheet

As part of the detailed Stage 2 assessment, a "Technology Fact Sheet" would also be prepared describing all the treatment aspects of the technology. Details covered in the fact sheet would include:

- A description of the technology
- The fundamental principles behind the technology
- Anticipated cost of implementing the technology
- Possible restrictions associated with the technology.

All agencies working in association with the ESTPA process would be given access to all data with respect to any given technology. This information will be made available through a limited access Internet site. All data will also be forwarded to UNEP/IETC's Environmentally Sound

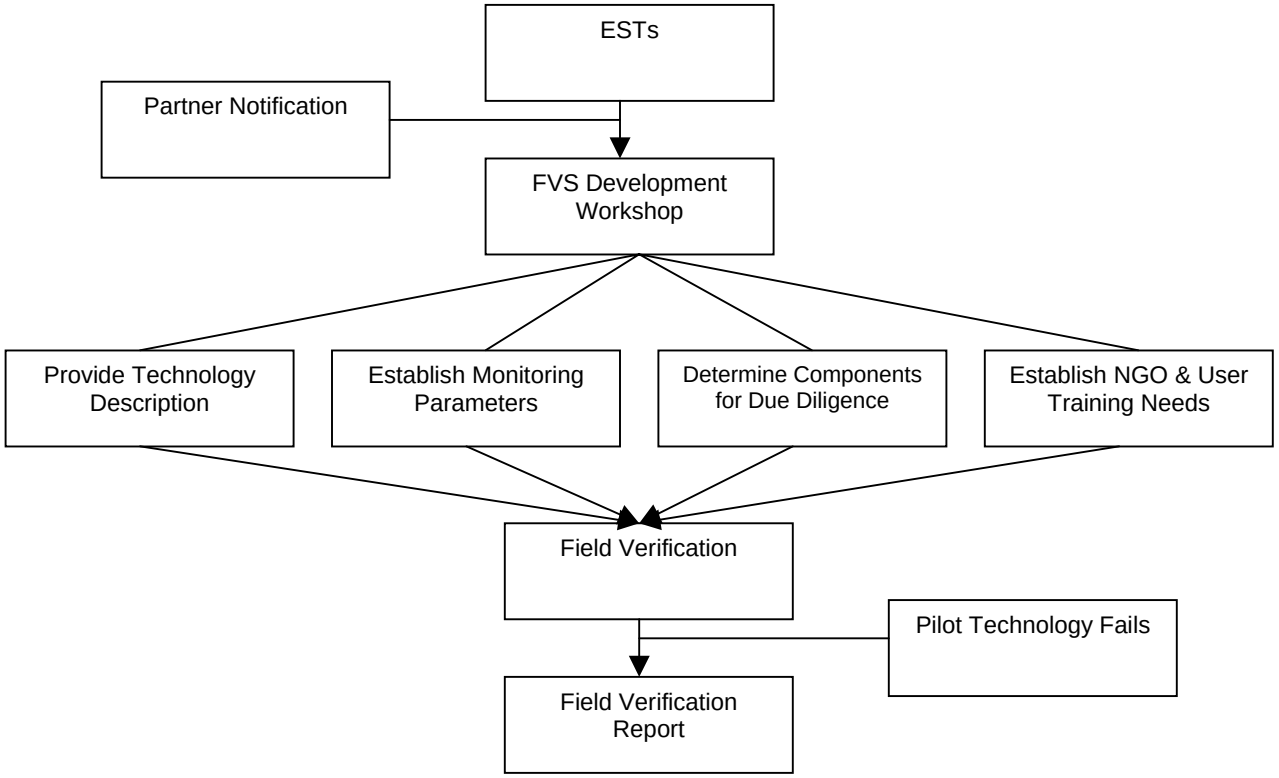
Technology Information System, maESTro, the central mechanism for maintaining a database of all information pertaining to ESTs.

ESTPA Stage 3 – Field Verification

Technologies that pass through the detailed assessment stage are then ready for the Field Verification Stage (FVS). The goal of the field verification stage is to determine whether, under varying conditions and application modes, the technologies actually perform according to the established criteria.

Figure 4 outlines the steps in the FVS process for any candidate technology. The FVS would begin with a workshop, involving relevant governments, international aid agencies and NGOs, to obtain input on both the technical and social components. The workshop would address four components with respect to performing the FVS: technology overview, monitoring, socio-economic and environmental due diligence, and training.

Figure 4: ESTPA Stage 3 – Field Verification for ESTs



Technology Overview and Description

The workshops would begin with a detailed description of the candidate technology to be piloted, including the chemical and physical aspects of the technology (ies), how these parameters are related to the criteria, and strengths and weaknesses of the technology identified during assessment. The technology overview would also provide an opportunity to discuss options for enhancing some of the potential technologies.

Monitoring Parameters

The second component of the FVS would be a detailed field test protocol for monitoring the performance of the pilot technology(ies). This would include the establishment of formal mechanisms for data collection and statistical analysis. The experimental design parameters would be clearly defined in order to generate representative data, including:

- **Site Assessment** – To understand the potential variables that may impact a given technology, a detailed site assessment would be undertaken in association with the FVS partners. Site assessment would be based upon, but not restricted to, the following parameters: geographical location, ecology, chemistry, and social and economic variables.

- **Quantitative Parameters** – A set of measurable parameters would be established to determine the effectiveness of a given technology. Parameters identified for monitoring during the FVS should correlate with parameters monitored during Stage 2 – Detailed Assessment. Correlating field data to the laboratory data collected provides a mechanism for

strengthening the initial assessment programme through the identification of key parameters that appear to significantly impact given technology types. Quantitative parameters monitored during the FVS would include, but not be restricted to, the following: treatment efficiency, chemical requirements if applicable, flow rates, maintenance requirements and time, and operational cost.

- **Qualitative Parameters** – "Soft" parameters would also be identified and assessed in the FVS. Input from individuals, families or communities regarding a given technology is important in determining long-term social acceptance. The best technologies should not only meet the quantitative criteria, but should also be ones that can be used most effectively by the target users in an environmentally sound manner. Qualitative parameters monitored during the FVS would include, but not be restricted to, the following: ease of use, incorporation into existing systems, durability, time, and perceived cost and benefits.

- **Data Management** – All information from the FVS would be formatted to allow incorporation of data into current systems and allow for detailed statistical assessment. The ESTPA process would utilise the data management criteria established in Stage 2 to assess the information gathered. Utilisation of the existing database permits a rapid comparison of data from the laboratory to be made with data collected in the field.

Socio-Economic and Environmental Due Diligence

In assessing technology performance, it is imperative to consider socio-economic, cultural and environmental issues. A candidate technology that is technically sound may nevertheless fail in its implementation because of social, economic, technical, cultural and environmental constraints. The workshop would be used to determine if due diligence with respect to socio-economic and environmental parameters is required. Components requiring due diligence that may be brought forward for integration include: manufacturing, distribution, maintenance, and disposal. Important factors such as expertise, training, capacity, credit, government regulation and gender-differentiated impacts would all be evaluated to determine if implementation of the technology is feasible.

Training

UNEP/IETC recognises the need for people to have the necessary tools to develop their own knowledge base and assume responsibility for their own decisions. By working in association with government agencies and other organizations in developing countries, UNEP/IETC is promoting the use of the ESTPA process as a tool for providing the information people require for informed decision-making, as well as mechanisms for disseminating this information.

Through the ESTPA workshop process, government agencies, international agencies and local NGOs would identify and assist in developing information and education programmes around specific environmentally sound technologies. Education is likely to be needed on the following: the current situation, technologies being proposed and used, needed changes in current practices, problems within current programmes, recognition of the need for technology replacement or optimisation, gender differentiated impacts, etc.

A Field Verification Management Plan (FVMP) that establishes the basic parameters outlined is expected to result from the FVS workshop. This Plan would serve as the basis by which all agencies involved with the field verification of the technology would operate, while recognising

that the FVMP should be flexible enough to allow for necessary modifications and/or improvements.

Institutional Capacity Building

UNEP/IETC is seeking to align the ESTPA process with the programmes and initiatives of local governments. Through its collaborating partners, UNEP/IETC can also offer technical assistance in developing local institutional capacity for the transparent and reliable assessment and evaluation of technologies. Possibilities for achieving this include:

- Integration of the ESTPA process with national government programmes
- ESTPA team members working directly with government agencies as technical and organisational advisors
- Visits by government representatives to other countries to observe and participate in the ESTPA process.

The limited capacity of private and academic laboratories to independently conduct the rigorous protocols outlined by the ESTPA process is also an important factor. UNEP/IETC, in collaboration with its programme partners, will therefore help laboratories in developing countries in establishing QA/QC protocols, and encourage them to establish internationally recognised management systems such as those under the purview of the International Organisation for Standardisation (ISO). Furthermore, in order to enhance the capacity of governments in developing countries, UNEP/IETC and its collaborating partners will provide assistance in the development of relations with recognised international agencies which can offer technical advice.

The UNEP International Environmental Technology Centre

Established in April 1994, the International Environmental Technology Centre (IETC) is an integral part of the Division of Technology, Industry and Economics (DTIE) of the United Nations Environment Programme (UNEP). It has offices at two locations in Japan - Osaka and Shiga.

The main function of IETC is to promote the application of Environmentally Sound Technologies (ESTs) in developing countries and countries with economies in transition. IETC pays specific attention to urban problems such as sewage, air pollution, solid waste, noise, and to the management of fresh water basins.

IETC is supported in its operations by two Japanese foundations: The Global Environment Centre Foundation (GEC), which is based in Osaka and handles urban environmental problems; and the International Lake Environment Committee Foundation (ILEC), which is located in Shiga Prefecture and contributes accumulated knowledge on sustainable management of fresh water resources.

IETC's mandate is based on Agenda 21, arising from the United Nations Conference on Environment and Development (UNCED), also known as the Earth Summit. Consequently, IETC pursues a results-oriented work plan focussing on three issues, namely: (1) Improving access to information on ESTs; (2) Fostering technology cooperation, partnerships, adoption and use of ESTs; and (3) Building endogenous capacity to address environmental problems.

IETC has achieved specific results establishing it as a Centre of Excellence in its areas of specialty. IETC products include: an overview on existing information sources for ESTs; a database of information on ESTs; a regular newsletter, a technical publication series and other media materials creating public awareness and disseminating information on ESTs; Local Agenda 21 documents developed for selected cities in collaboration with the United Nations Centre for Human Settlements (UNCHS Habitat) Sustainable Cities Programme (SCP); advisory services; Action Plans for sustainable management of selected lake/reservoir basins; assessment surveys of training needs in the field of decision-making on technology transfer and management of ESTs; design and implementation of pilot training programmes for adoption, application and operation of ESTs; training materials for technology management of large cities and fresh water basins; and others.

The Centre coordinates its activities with substantive organisations within the UN system. IETC also seeks partnerships with international and bilateral finance institutions, technical assistance organisations, the private, academic and non-governmental sectors, foundations and corporations.

OCETA

OCETA is a not-for-profit corporation mandated to provide business services to public and private sector organisations. These services include assistance to entrepreneurs, start-up companies and small to medium-sized enterprises (SMEs) seeking to commercialise new environmental technologies. OCETA also operates the Canadian environmental technology verification programme under license from Environment Canada.

Since its inception in 1994, OCETA has been a catalyst for action and has established programmes and provided services to address environmental issues such as sustainable development, technology verification, greenhouse gas reduction, energy efficiency, remediation, water/wastewater treatment, and recycling.

OCETA works closely with industrial associations, universities, research centres, and all levels of government in assessing and evaluating the environmental performance of technologies, including their technical and financial viability.