United Nations Industrial Development Organization

Technology Transfer: from Data to Knowledge

Background Paper

'2nd CTI/Industry Joint Seminar on Technology Diffusion in Asia'

&

'UNFCCC: Asia & Pacific Regional Workshop on Transfer of Technology'

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1. Background

Decision 4/CP.4 of the Buenos Aires Plan of Action (BAPA), on the 'Development and Transfer of Technologies', annexed a list of issues and questions. This paper examines issues 9, 12 (technology information) and 13 (technology centres and networks)[1] and will hopefully provide some ideas to the Workshop participants on how to respond to the questions.

It should be kept in mind that for industry in Non-Annex I countries to benefit from the Clean Development Mechanism (CDM) of the Kyoto Protocol, the following additional issues must also be addressed:

- 4 (removal of barriers to technology transfer);
- 7 and 8 (an enabling environment for and involvement of the private sector);
- 11 (assessment of technologies); and
- 16 (technical advice on technology transfer).

2. Technology information

The subject 'technology information' (data collection, access and provision and systems of support) is frequently referred to in discussions on transfer of technology because the two issues are so closely related as to be inseparable in operational terms:

- Integrated information mechanisms must be available to the various processes that constitute the subject 'technology transfer' i.e.
  - identification
  - assessment
  - selection
  - acquisition
  - adaptation
  - application and
  - absorption;
- Data managed by these information mechanisms must be accompanied by locally available expertise
  - in the specific sectors of programmes/projects
  - on the technologies in question and
  - in the processes involved.

However, in some of the documentation presented to the Parties to the United Nations Framework Convention on Climate Change (UNFCCC), 'technology information' has

[1] Readers should keep in mind that, as the paper has been prepared by the United Nations Industrial Development Organization (UNIDO), it will, of necessity, concentrate upon the industrial sector.

been considered as a related but separate issue.[2] Therein lies a danger, as the focus is shifted away from the subject of 'technology transfer' with all of its technical implications, to that of 'information' where the accent is upon data access, data systems, clearinghouses and dissemination mechanisms. There are many references, in more recent submissions by Parties to SBSTA[3], where this shift of focus is evident. In this respect it should be noted that information systems alone, without matching facilities and abilities to transform data and information into locally applicable knowledge, will not be sufficient. This has already been recognized by some of the Parties[4].

The discussions on technology information and technology information centres will make more progress if they focus on the application of data and information to specific problems (sector, site, technology and project-specific). It is at these levels that the needs of Non-Annex I countries for technology and technology information will be more appropriately identified.

In FCCC/CP/1998/MISC.5[5], one can see the same line of thought being followed:

"Technology transfer issues are complicated and site and technology specific ...", therefore there is a need for instruments that provide *"... sufficient level of detail that would help ... to really ascertain developing country technology needs in order to achieve concrete results."*

2.1 Information or knowledge centres?

> Is the development and/or enhancement of technology **information centres** *per se* appropriate for technical issues such as those that need to be dealt with by the industrial sector in developing countries?

The submissions of the Parties refer to existing stores of technology information and existing technology information centres. However, most of the technical and economic information likely to be required is located in developed countries while those information centres in Non-Annex I countries that may have access to some of this information are not necessarily able to put it to effective use beyond their own walls.

According to the experience of UNIDO, generalized industrial and even environment-focused information centres have proven unsustainable, as industrial clients need more than that which 'traditional' information centres -- i.e. centralized reference-services

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[2] *Options for technology information centres and networks* (SBSTA/1998/INF. 2); *Technology and Technology Information Needs Arising from the Survey of Developing Country Parties* (SBSTA/1998/INF. 5); *International technology information centre(s): possible functions and institutional and financial arrangements* (SBSTA/1998/Misc. 4)

[3] SBSTA 10, Misc. 5 and Annexes

[4] Op. cit. Ref. 3

[5] *Development and Transfer of Technologies (Decision 13/CP.1), Submission by Parties*, FCCC/CP/1998/MISC.5, 4 September 1998

(library-type, bibliographic focussed) -- supply. Traditional information centres abound with an increasing number of networks of national and/or regional focal points with wide subject-coverage. In addition, many organizations have initiated Internet-based information provision facilities in the last few years.

However, one should be thinking in terms of dynamic, user-oriented, 'local' systems to deliver to clients what they 'really need', i.e. to convert data and information into the knowledge required to solve specific technological problems through

> *processed and competently assessed* technical and economic information that is tailored to their country-, sector-, technology, project- and site-specific needs.

These needs can **only be determined by sectoral experts** who will require access to a range of data, information, tools and methodologies to assist with **technology assessment** (in the generic as well as in the process specific sense). If this is accepted, then we are thinking more in terms of a 'knowledge delivery system' than of an 'information delivery system'. The former requires a mix of technical, diagnostic, economic and information skills to address the problems at the root level where they occur. For example for the industrial sector, the system will need to identify:

- Technological problems (needs) of a factory through audits;
- Most suitable and available technologies that may address these needs;
- Particular solution(s) that can be recommended, which may require adaptation to actual circumstances;
- Impacts (on the environment and the economic viability of the facility).

In addition, the system will, *inter alia*, need to have:

- Information management and delivery skills to collect and store national data and to access and package the international data required;
- Marketing skills to promote the need for the assessments in the first place;
- Regulatory powers to establish the framework for and to 'encourage' industry to change; and, not least
- Access to financial agents to go beyond analysis and problem identification to actual implementation of solutions.

From the above it is clear that such a system cannot be undertaken by either an information or even any single technology centre alone. Therefore, especially in developing and emerging economy countries, there is

> an urgent need to establish **strategic alliances of stakeholders and 'knowledge centres'** (or 'virtual' centres) and link these into regional and/or international 'knowledge networks'.

According to the International Institute for Sustainable Development (IISD) a 'knowledge network' would assist *"...to create new knowledge, but also to accelerate the application of that new knowledge to economic or social development"* [6]

Most of the discussions on technology information have concentrated on traditional approaches to data management and dissemination with little thought given to the **application of data to specific problems**. The latter requires a different approach to that of a traditional information system, one that needs technically oriented institutions and experts as much as information specialists. Therefore, in the context of technology transfer for the Kyoto Mechanisms, the concept of national knowledge centres is more appropriate than that of technology information centres.

In this concept, a national knowledge centre is connected to other national knowledge centres (creating a national 'virtual centre' or otherwise inter-linked 'knowledge network') as well as to regional and international 'knowledge networks'. A knowledge network (together with its component 'knowledge centres') has the following characteristics[7]:

- It exists *"...for the purpose of creating and disseminating new knowledge..."*, rather than in just providing access to existing sources of information—i.e. it is dynamic rather than static. This knowledge will be applied in the pursuit of solving developmental problems, preparing new policy instruments, developing new products and services etc.;
- The knowledge is widely distributed and made available to the global community;
- The network is *'structured'* to *"...maximize the rate at which new knowledge is discovered"*;
- The network should provide *"...clear, recognizable and direct benefits..."* to its stakeholders—i.e. the application of the results for immediate benefit of the stakeholders. For instance, business and industry, as key stakeholders to the CDM, are unlikely to become involved if they cannot see a clear benefit;
- It is advisable that such a network is *'formally'* organized and managed and has well-qualified participants. All interested and affected parties, at all levels of society, should have a voice within the network;
- The network should have a *"...well-developed communications strategy"*; and
- The network should *"...transcend boundaries"*, i.e. political, national, institutional and sectoral areas of competence.

UNIDO has supported the creation of national industrial technology centres, national and regional energy/environmental information systems, and regional and international technology networks that meet many of the above criteria. The experience gained through those activities will be available to Non-Annex I countries for capacity building programmes and projects that will 'enable' the transfer of technology under the CDM.

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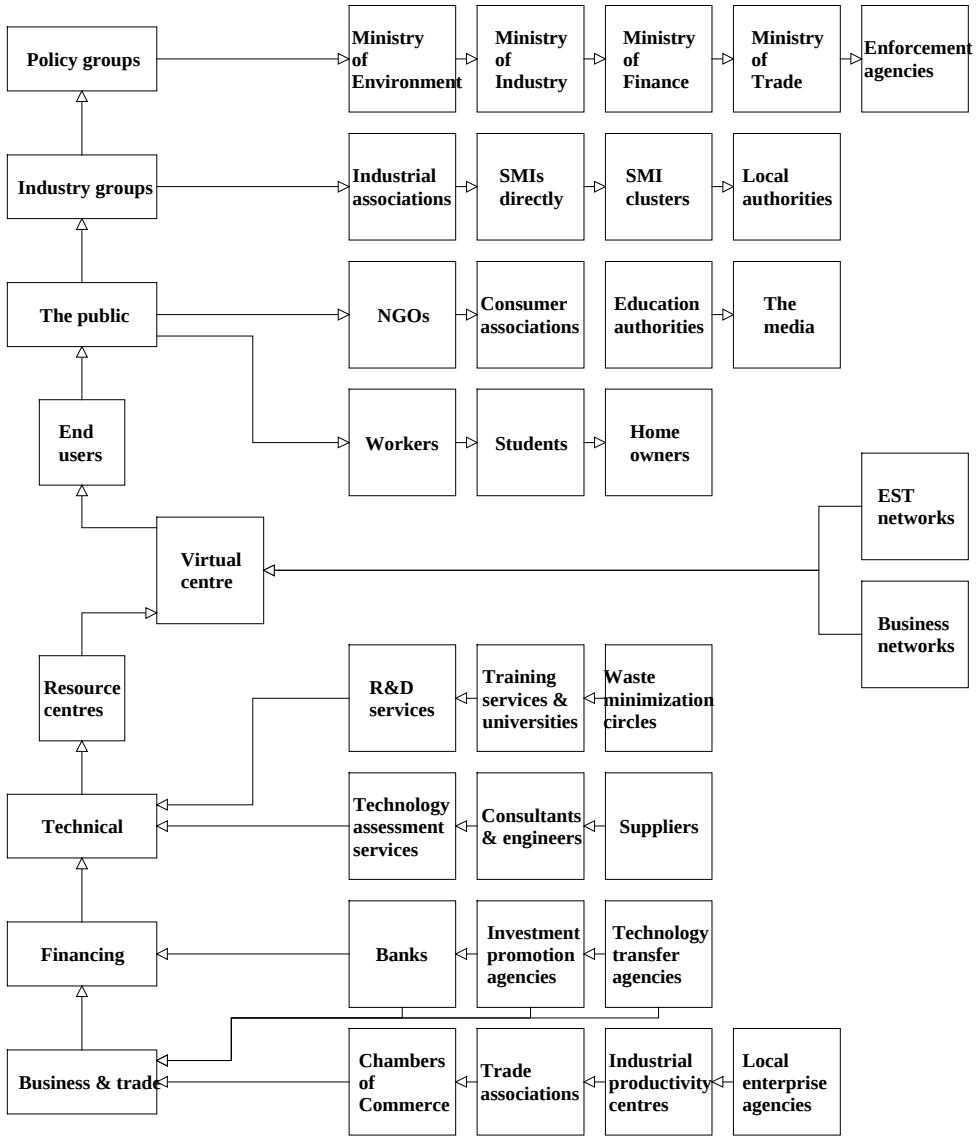
[6] *Formal Knowledge Networks, A Study of the Canadian Experiences*, IISD, 1998
[7] Interpreted and quoted from Op. cit. Ref. 6

Figure 1 provides an idea of potential national stakeholder groups for industry including policy, industrial institutions, bodies representing the publics' interest, academic and technical facilities, financial institutions, and business and trade. These stakeholder groups can either contribute to (resource centres) or benefit from (end users) the processes involved in technology transfer. There will need to be a co-ordinating body at the national level (the 'virtual centre' box), into which international sources of information and business/investment contacts should flow.

Figure 1 -- Potential stakeholders



2.2 What type of data?

A knowledge-based system goes well beyond that which traditional reference information centres can provide. However, this does not mean that there is no role for such centres.

Traditional information systems could, for instance, provide access to generally available publications and reference manuals from which sectoral experts can obtain

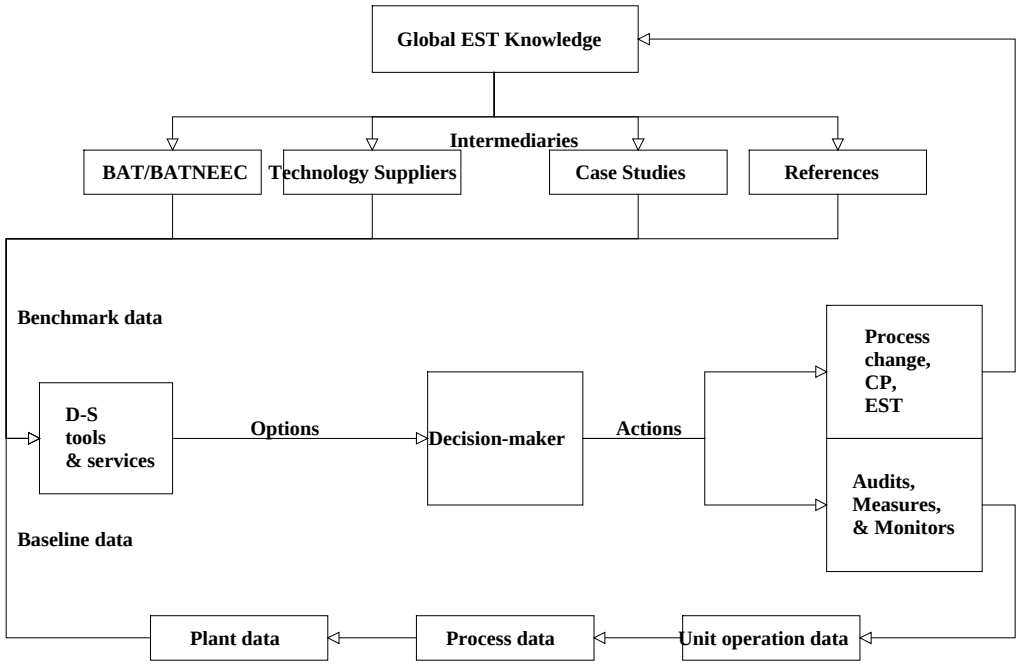
***"Benchmark data** — knowledge of the sector, which will be obtained from previous case studies or reports on best-available technologies (BATs) from suppliers and literature references. This sort of data can be provided by a variety of information and/or technical service intermediaries in a variety of formats, through a variety of means."*[8]

However, before utilizing any 'benchmark' data, sectoral experts needs to obtain data from an industrial enterprise

***"Baseline data** — that which will be collected through monitoring and auditing of a plant ... This will basically be materials balances from unit operations and processes and a review of the technology (hard & software) as applied in the plant. Such **data can only be collected and processed by technically proficient, sectoral specialists**, as opposed to information professionals."*[9]

Figure 2 presents a schematic diagram of the concept 'data to knowledge', concentrating on the main sources of benchmark and baseline data for technology needs assessment.

Figure 2-- Data Flows for Decision-making



[8] *Working Paper on Information Networking for SMIs*, input to the Environmental Technology Assessment System (ETAS) project for the Philippines, Pembleton, P., UNIDO, August 1997
[9] Op. Cit. Ref. 8

The concept requires

"Both the benchmark and the baseline data" to be channelled *"through a 'decision-support' system (this can be an expert, a consultancy/research body, or a more advanced expert system), which will result in a set of options to be presented to the decision-maker for action."* [10]

As the types of support required for these processes will not be available for all relevant sectors in any one institution, a network of extension and other technology-related services is required.

3. Technology services

There are a number of technology-related services required for the operation of technology transfer mechanisms in Non-Annex I countries and these services in turn require information system support. Figure 3 shows some of the other types of data and information related to services provided by different technology intermediaries, for example:

- Contacts to technology suppliers (technology and reference services);
- Training opportunities (reference services);
- Means of financing (investment and business services);
- R&D, etc.

Such services are best available nationally, not regionally or internationally. Regional or international centres may provide input to the processes.

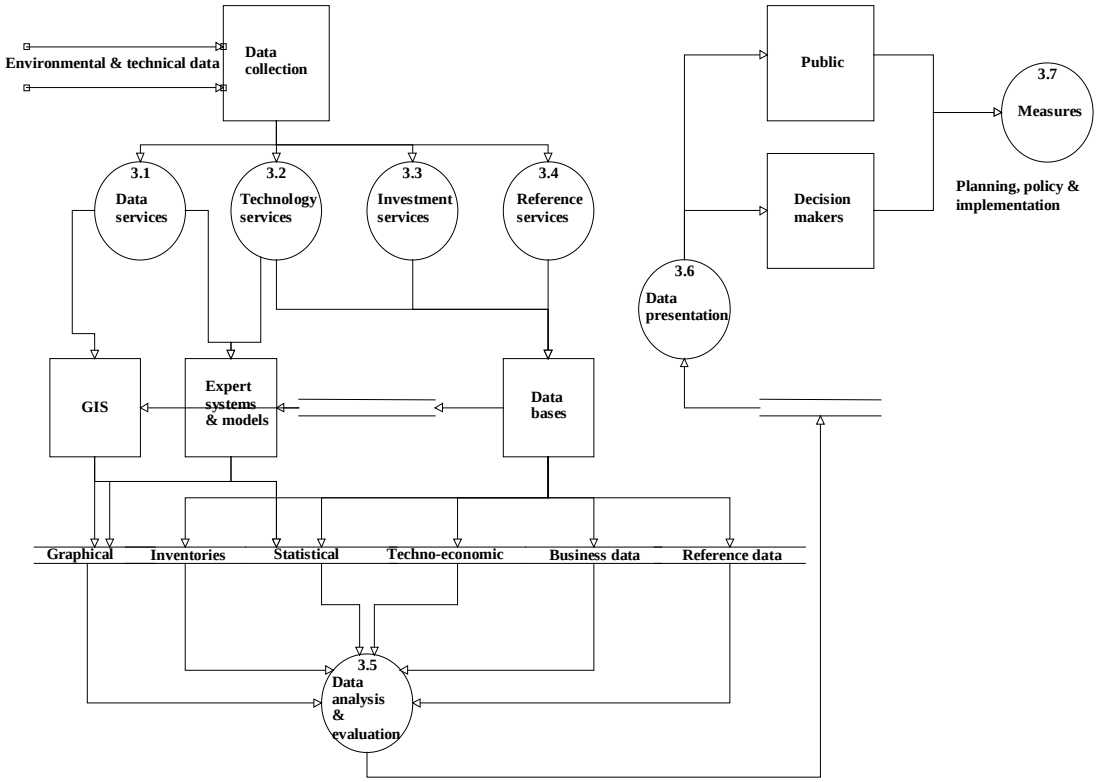
The list below presents an outline of UNIDO's services relevant to technology transfer, the UNFCCC and the Kyoto Protocol:

- Technology centres established
  - International Centre for Science and High Technology (ICS) in Trieste, Italy;
  - Centre for the Application of Solar Energy (CASE) in Perth, Australia;
  - International Centre for Small Hydro Power, in Hangzhou, China;
  - International Centre for Hydrogen Energy Technology in Turkey;
  - International Centre for Genetic Engineering and Biotechnology (ICGEB) in New Delhi, India;
- Energy and environmental networks established
  - National Cleaner Production Centres (NCPC) programme in co-operation with UNEP (currently 14 countries worldwide);
  - Environmental Technology Advisory Centre and Network (ETAC) in the Philippines;
  - Industrial Energy Conservation Network in Eastern Europe (9 sectors and 14 countries);

[10] Op. Cit. Ref. 8

- Technology assessment services
  - Preliminary inventory of industrial technology options;
  - Links between technology centres and industry;
  - Providing advice on the management of technology and innovation;
  - Helping industry choose the right options to increase competitiveness.

Figure 3 -- Other Possible Information Services



- Investment promotion network and services
  - International network of 14 Investment Promotion Offices (IPOs);
  - Assistance in identifying and brokering international partnership opportunities;
  - Assessing options for co-operation;
  - Evaluating offers;
  - Formulating agreements;
  - Facilitating negotiations;
  - Constructing financial proposals;
  - Applying for credit from national and international funding bodies and capital providers.
- Technology negotiation services
  - Guidelines and assistance on build-operate-transfer (BOT) mechanisms;
  - Support to international business partnerships;
  - Training in negotiating skills;

- Training on the preparation, negotiation and operation of industrial partnerships such as joint ventures and strategic alliances;
- Support to drafting appropriate contracts.

- Tools
  - Computer model for assessing the costs and benefits of industrial greenhouse-gas mitigation strategies 'Identify';
  - Computer Model for Feasibility Analysis and Reporting (COMFAR);
  - Manuals for the preparation of industrial feasibility studies and the evaluation of industrial projects.
  - *Manual on Technology Transfer Negotiations*, a training kit for practitioners and the training of trainers;
  - Manuals and guides on joint ventures and strategic business alliances.

4. Next steps

The annex to Decision 4/CP.4 on technology transfer contains three issues related to this section, namely:

- 1 and 2 (multilateral agency support to technology co-operation and transfer); and
- 17 (programmes of capacity building).

The last item is currently coming into the centre of the debate on the Kyoto Mechanisms, as it is important for many of the discussions and also a pre-requisite for the operation of the Mechanisms as well as for the related topic of technology transfer.

The Group of 77 and China prepared a draft decision for the last session of the Subsidiary Body for Scientific and Technological Advice (SBSTA) stating their views on capacity building that was later annexed to a decision on capacity building at COP5.[11] This is, in effect, a 'position paper' placing the issues of Decision 4/CP.4 into a framework for action by the international community. The annex lists priority areas for action that include the following that clearly fall within the competence of UNIDO wherever industry is concerned:

- Institutional capacity and alliances;
- Human resources;
- Project negotiation, technology assessment and transfer;
- Data, information and knowledge for decision making; and
- Networking.

UNIDO has developed a strategy and a series of concepts for technical assistance for our industrial clientele to participate in and benefit from the Kyoto Mechanisms in accordance with the capacity building concerns expressed in both the Buenos Aires Plan of Action and the SBSTA draft decision. In addition, a preliminary programme of assistance to the Africa region has just completed its first phase and will soon be starting

[11] FCCC/CP/1999/10.CP5

on the second phase. The strategy *inter alia* includes enhancement of the technological capacities that support industry in Non-Annex I countries through 'hands-on' capacity building activities covering the ideas and experiences mentioned in the previous sections of this paper.

Capacity building

In order to develop the 'necessary conditions' for the investment and transfer of technology likely to be mobilized through the Clean Development Mechanism, national capacity to address a range of pre-project, project and post project launch issues will be required, such as:

- Pre-project issues
  - identification and removal of barriers to technology transfer and absorption
  - identification of national sustainable (industrial) development objectives and appropriate criteria
  - identification of technology and technology information needs
  - access to and utilization of appropriate sources of information
  - preparation of sectoral and national baselines
  - support to the processes of foreign direct investment (FDI--e.g. matchmaking services, investment events);
- Project issues
  - formulation and development of CDM projects
  - application of baselines and determination of additionality for CDM project
  - assessment of technologies to determine their appropriateness
  - negotiation with project/technology sponsors;
- Post project launch issues
  - management of the process of technology transfer
  - management of the projects (technical and economic aspects)
  - management and absorption of the technologies once transferred under the CDM
  - monitoring the projects and
  - certifying emissions' reductions from the projects.

From the above list it can again be seen that technology information is only one component of a broader system of national support needed to facilitate the transfer and management of technology and the increased inflow of FDI. Without, for instance, matching services that will 'interpret' and add value to that which is provided through traditional information channels, the necessary accumulation of locally-applicable knowledge will not occur.

A three-step approach might be considered for developing national capacity building programmes to support the CDM in Non-Annex I countries. It would be best to start small and 'learn-by-doing' by selecting a few indicative countries as a regional initiative and undertaking pilot activities in each as follows:

- Step 1--capacity mapping
  - identify existing national centres and services that could form the basis for a national knowledge and technology support network (stakeholder group) that will assist with all the CDM-related processes outlined above. Review their existing capacities and define capacity gaps. This step includes the identification of specific needs, national development objectives, criteria and baselines
  - cross fertilize the results through holding workshops with all national experts from the project;
- Step 2--programme/project framework
  - prepare integrated national capacity building programmes for technical assistance based upon the capacity maps. The programmes should *inter alia* address the list of items mentioned above and include the technology services presented in Chapter 3;
- Step 3--programme implementation
  - enhancement of the national technological and other support capacities through, *inter alia*, training, provision of equipment, support to demonstration projects, development of knowledge networks (stakeholder alliances) and facilitating access to and, more importantly, utilization of sources of technological information;
- Step 4--duplicate steps 1-3 in other countries of the region.

UNIDO can assist with the above steps by drawing upon its own expertise and experience (as well as its industrial, research and energy institution partners) in the areas of sustainable industrial development, capacity building, technology transfer and project implementation. More importantly, UNIDO's service module approach can bring to bear the different programme components that are available in the Organization in a integrated manner, based upon a solid foundation of knowledge about industry within the Asia and Pacific countries countries.

The main pre-condition for all the above is the availability of funding from the donor community and from national contributions. The latter includes staff and facilities traditionally provided by recipient countries but more importantly should include a national commitment and cost sharing that would ensure continuity of the support facilities beyond the cessation of incoming donor resources. The funding need not be high for the first two steps, but step 3 will require quite substantial funding for which the Global Environment Facility (GEF) could be one of the sources approached.