

# A programmatic review of UNIDO/UNEP national cleaner production centres

Ralph A. Luken <sup>\*</sup>, Jaroslav Navratil

*United Nations Industrial Development Organization, P.O. Box 300, Vienna, A-1400, Austria*

Received 4 March 2002; accepted 28 October 2002

## Abstract

The United Nations Industrial Development Organization (UNIDO) and the United Nations Environment Programme (UNEP) jointly initiated the National Cleaner Production Centres (NCPCs) programme in 1995 with the funding of eight centres. The centres and the CP assessors trained by them do not deliver ready-made solutions, but rather they train and advise their clients on how to find the best solutions for specific problems. Two UNIDO evaluations of the programme confirm that the methodology for implementing the CP concept at the factory level is an effective tool for identification and prioritisation of technology changes that yield both environmental and financial benefits. However, the dissemination and application of the CP concept to small and medium size (SMEs) on the basis of its own financial merits does not occur easily; hence, there is a need to support the dissemination of the concept through promotional (awareness raising, training) activities, national policy formulation and access to financing.

© 2003 Elsevier Ltd. All rights reserved.

*Keywords:* Cleaner production; National cleaner production centres; Capacity building; Global; UNIDO

## 1. Introduction

Chapter 34 of Agenda 21 endorsed by the UN Conference on Environment and Development in Rio in 1992 calls on international organizations, including United Nations agencies, to “promote, facilitate and finance as appropriate, the access to and transfer of ESTs and corresponding know-how, in particular to developing countries...” [1]. In response to this request, several bilateral and multilateral institutions have established programmes to promote the utilization of cleaner technologies and techniques in developing countries within the overarching concepts of cleaner production/pollution prevention.

The World Summit on Sustainable Development (Johannesburg, 2002) reviewed the obstacles to progress towards sustainable development and the results achieved since the endorsement of Agenda 21. The “Johannesburg Plan of Implementation” approved at the summit

recognized, amongst other things, the need to reduce unsustainable patterns of production in both developed and developing countries and called for yet again urgent action to promote, facilitate and as appropriate finance the development, transfer and diffusion of ESTs and the corresponding know-how to and amongst developing countries [2].

This article reviews one programme, the joint UNIDO/UNEP National Cleaner Production Centres (NCPCs), set up in response to Agenda 21 with the ultimate (developmental) objective being the widespread application of the CP approach at all decision-making levels in industry with a significant focus on the uptake of cleaner technologies and techniques within the industrial sector. The article starts with background information on the NCPC programme from its inception to its current status. Then, it moves on to describe the results achieved by the programme and puts forward conclusions and lessons learned that need to be taken into account in designing new and modifying existing programmes for reducing unsustainable patterns of industrial production in developing countries.

The article is based on two in-depth evaluations of the UNIDO/UNEP NCPC programme undertaken by

<sup>\*</sup> Corresponding author. Tel.: +43-1-26026-3352; fax: +43-1-21346-5031.

*E-mail addresses:* [r.luken@unido.org](mailto:r.luken@unido.org) (R.A. Luken); [j.navratil@cbox.cz](mailto:j.navratil@cbox.cz) (J. Navratil).

UNIDO's evaluation unit and other documents available at UNIDO headquarters [3,4]. Four other evaluations/reports about the programme, either in their entirety or partially, were found as part of the preparatory process for writing the article. One was an evaluation undertaken for UNIDO at the end of 1995, with only one year of programme operation [5]. The evaluation was limited to project design and administrative arrangements as the NCPCs had barely begun their programmatic activities. The second was a comparative analysis of several different donor sponsored CP programmes by the US Agency for International Development and the Swiss Federal Office for Foreign Economic Affairs [6]. Five of the 22 interviews undertaken for the report were with the directors of NCPCs. The analysis addressed programme design and management issues as well as commenting on the relative importance of various programmatic activities undertaken by cleaner production centres. The third was a critique of the UN mandate for EST as set forth in Agenda 21 and a secondary source critique of the NCPC programme. It suggested that the lack of integration of NCPCs into national systems of innovation makes the NCPC role limited and peripheral [7]. The fourth is advice on how to set up an NCPC and a description of the six programmatic functions typically undertaken by an NCPC [8].

## 2. Background

### 2.1. Purpose of the NCPC programme

The basic premise of the UNIDO/UNEP NCPC programme is that cleaner production can only be sustained in a country if there is capacity in place to adopt it. True appreciation of cleaner production and therefore its application can only come about if the concept is promoted by professionals in the beneficiary country itself and adjusted by them to the local conditions. Building capacity to do this through the centres is the main objective of the programme. The programme targets the transfer of know-how and not the transfer of technology. The centres and the cleaner production assessors trained by them do not deliver ready-made solutions; rather they train and advise their clients on how to find the best solution for their specific problems.

During the three to five years it takes UNIDO to fully establish its centres, the latter build capacity in the process of offering six basic services:

- Awareness-raising with short seminars up to one day duration and dissemination of general CP information;
- training as professional training in CP methodology used in in-plant assessments;

- technical assistance, both in the form of in-plant CP assessments and in other ways;
- advice on sources of financing for cleaner technologies;
- information dissemination as technology information needed for in-plant assessments;
- policy advice.

### 2.2. Brief history and status of the UNIDO/UNEP programme

The report from UNIDO's Conference on Ecologically Sustainable Industrial Development called upon UNIDO to assist developing countries build "institutional capacity to develop, absorb and diffuse pollution prevention techniques and cleaner production processes essential to making the transition to ESID" [9].

The UNIDO Energy and Environment Unit finalized a project document requesting donor support for the establishment of National Cleaner Production Centres in July 1992 and submitted it to the Government of the Netherlands in November 1992, receiving a funding of US\$ 1.6 million in 1994. The project document called for a joint programme between UNIDO and UNEP, with UNIDO acting as the executing agency and UNEP's Industry and Environment Programme Activity Centre providing professional support (methodology and information). This Phase One document envisaged supporting eight to nine NCPCs for three years.<sup>1</sup> In February 1993, UNIDO and UNEP requested developing countries to apply, on the basis of guidelines issued by these two organizations, as host countries for NCPCs. The guidelines stated that an NCPC could be located in industrial trade associations, chambers of commerce and industry, industrial productivity centres, universities or other industry-oriented organizations. UNIDO received

<sup>1</sup> The brief description in the project document reads as follows: "UNIDO's Environment and Energy Branch and UNEP's Industry and Environment Programme Activity Centre propose to support National Cleaner Production Centres (NCPCs) in approximately 20 countries for a five year period. The NCPCs will serve a coordinating and catalytic role for cleaner production by providing policy advice on environmental management, supporting demonstrations of cleaner production techniques and technologies, training industry and government professionals in this new area of industrial environmental management and by being a source of information on cleaner production. They will become the core of a network of institutions and individuals involved in pollution prevention activities, they will be managed by experienced country nationals and hosted in existing institutions. Phase I of this programme will support eight–nine NCPCs for three years. Phase I of this programme will test the effectiveness of this approach for the promotion of pollution prevention/source reduction as an important complement to end-of-pipe pollution control efforts. Phase I achievements and experiences will form the basis for an application to Special Purpose Donors and UNDP for Phase II, which, if accepted, would fund the eight–nine existing NCPCs for two more years and 12 new NCPCs for five years".

applications from 39 institutions in 25 countries on the closure date of October 1993. In November 1993, an expert panel selected nine institutions/countries based primarily on the strength of the host institution and qualifications of the potential head of the centre (called the Cleaner Production Promoter) and taking into account regional distribution. UNIDO and UNEP undertook field visits to the semi-finalists in mid-1994 and announced the five finalists (China, India, Mexico, Tanzania and Zimbabwe) for the programme in November 1994. In addition, Brazil was selected conditionally based on the availability of funds, both its own and those from UNIDO and UNEP. In 1994, UNIDO also proposed centres and found funding from Austria for NCPCs in the Czech Republic and Slovakia. Officially, the NCPC programme started for the seven centres in January 1995 with Brazil joining in June 1995 on the basis of a self-financed trust fund. Collectively in this article, these eight centres are referred to as the “old” NCPCs.

The current status of the NCPC programme (January 2003) is that the programme has funded 25 centres. Table 1 indicates the starting and closing dates and amount of general support funds made available. In most cases, funding for each NCPC includes the salary for the Cleaner Production Promoter (Director), a start-up office, minimal in-plant monitoring equipment if needed,

installation of computerized data management, funds for international (mostly in the twinned institutions) and national experts, study tours, training and travel. The only centre with a full-time international advisor is the one in Vietnam.

The total budget for centre specific activities is US\$ 17.4 million as of January 2003. In addition, the centres collectively benefit from global activities in the field of CP undertaken by UNIDO and UNEP. Most of the budget (85%) is funded by donor countries (the bulk being from Switzerland, Austria, Norway, the Netherlands, and Italy), the remaining part by multilateral organizations (UNEP, UNIDO, UNDP—10%) and through self-financing (Brazil, Oman, Republic of Korea, Russia—5%).

The budget for the “old” NCPCs including initial preparatory work amounted to US\$ 4.7 million with all the money already spent. The material in this article draws primarily on the experience of the NCPCs in this category.

### 2.3. Types of activities/services of the NCPCs

The first tranche of NCPCs, a standard UNIDO/UNEP NCPC, once established and operational was expected to conduct at least the following core activities: training, in-plant assessments, dissemination of information and

Table 1

Location of NCPCs, time span of operation with UNIDO funding, donor country and amount of funds (as of January 2003)

Country	Start of operation with UNIDO	End of operation with UNIDO	Donor	Amount (US\$)	Amount per year (US\$)
Brazil	1995	1998	Brazil	330,000	110,000
China	1995	1998	The Netherlands	310,000	103,000
Costa Rica	1998	2003	Switzerland	1,123,000	224,600
Croatia	1997	1999	Czech Republic	175,000	58,100
Czech Republic	1994	1999	Austria	603,000	120,600
El Salvador	1998	2003	Switzerland	1,123,000	224,600
Ethiopia	2000	2002	Italy	708,000	236,000
Guatemala	1999	2004	Switzerland	1,123,000	224,600
Hungary	1997	2000	Austria	444,000	148,000
India	1995	1998	The Netherlands	310,000	103,000
Kenya	2000	2002	UNDP	421,000	140,300
Republic of Korea	2001	2003	Republic of Korea	610,000	203,000
Lebanon	2002	2004	EU/Austria	200,000	100,000
Mexico	1995	1998	The Netherlands	310,000	103,000
Morocco	2000	2005	Switzerland	1,334,000	266,800
Mozambique	2000	2002	Italy	713,000	237,600
Nicaragua	1997	2002	Austria	805,000	161,000
Slovakia	1995	2000	Austria	517,500	86,200
Sri Lanka	2001	2006	Norway	1,200,000	240,000
South Africa	2002	2007	Switzerland, Austria	1,500,000	300,000
Tanzania	1995	1998	The Netherlands	310,000	103,000
Tunisia	1996	1998	Norway	66,500	33,200
Uganda	2001	2003	Austria	708,000	236,000
Vietnam	1998	2003	Switzerland	2,550,000	510,000
Zimbabwe	1995	1998	The Netherlands	310,000	103,000
TOTAL				17,804,000	

policy dialogue. Based on the experience with these NCPCs, the newer NCPCs are expected to conduct these core activities plus assistance in finding investment funds for cleaner technology. It is apparent that there are justifiable differences between the “new” NCPCs (Nicaragua, El Salvador, Costa Rica, etc.) and the “old” ones. In the case of Tunisia, the USAID Environmental Pollution Prevention Programme set up and provided the initial funding for the centre. UNIDO/UNEP involvement came after the support from USAID ended and was very limited as can be seen by the amount made available to the centre.

All NCPCs are engaged in the following core activities: short-term training (up to five days) and dissemination of generic information on cleaner production. All are engaged in conducting in-plant assessments (combined with training and demonstration activities). Most NCPCs are engaged in policy dialogue with different ministries or regional authorities (preparation of or comments on policy papers, etc.). Many of them also conduct training courses longer than five days and provide information on cleaner technology (CT).

The awareness raising function in the “old” centres was subsumed under training and information dissemination. This made the training and information services very heterogeneous. In the case of the “new” centres, awareness raising (short seminars up to one day duration) and dissemination of general CP information are singled out as two distinct activities. This has resulted in more precise definition of training as professional training in CP methodology used in in-plant assessments as well as in a more precise definition of information as technology information needed for in-plant assessments and CT application.

Some centres are also engaged in non-core activities. The most significant is cooperation of the “old” NCPCs with educational institutions in introducing CP subjects in their curricula. Some of the “old” NCPCs offer enterprises advice on Environmental Management Systems (EMS), environmental benchmarking, environmental management accounting and energy efficiency (conservation). Only a few indicate involvement in more complex activities such as life cycle analysis (LCA) and eco-design and only three of them provide on occasion advice on end-of-pipe (EOP) treatment if it complements the CT measures. No NCPC is reported to have been involved in hazardous waste management (even though other information suggests that at least the NCPC in Brazil was involved in this area). It is worth noting that only some of the “old” NCPCs have advised companies on financing and transfer of technology related to CP.

### 3. Results

#### 3.1. Reported results

NCPCs are expected to report to UNIDO and UNEP semi-annually on their activities. On the basis of these reports, a standard “NCPC Activity Report” for the whole programme is compiled by UNIDO. The only complete set of key indicators, taken from the “First Quarter 1999 Activity Report with the exception of data on trained assessors”, is presented in Table 2.

The data presented in the table suggest that there are different interpretations by people from different NCPCs of the contents of some of the reported activities. This applies to the number of plants submitted to in-depth CP assessments, the number of trained CP assessors and the number of awareness raising seminars and activities. Interviews with individual NCPCs in the context of the 1999 evaluation also indicate frequent discrepancy between information provided in the course of these interviews and the key indicators contained in the activity report. For example, a later evaluation of just three centres (Czech Republic, Hungary and Slovakia) found some noticeable differences in the reported number of demonstration projects and trained CP assessors. Therefore, the information provided in Table 2 has to be considered with caution. Particularly, the number of trained assessors should not be interpreted as the number of assessors who actually are qualified to conduct in-plant assessments: these numbers are much lower.

Collection of information for this evaluation confirmed that most of the NCPCs do not have a well-established management information system, which would provide information on the activities, their costs and impacts. For example, it was difficult for some NCPCs to provide information on the implementation of CT options by enterprises. (It should be, however, highlighted that some NCPCs have a very good overview: NCPC Mexico was able to report on the percentage of implementation of every CT option.) None of the NCPCs has a good overview of how many CP assessors trained by the NCPC actually conduct regular in-plant assessments and what is the impact of their work (how many CT options were identified by them, how many were implemented, etc.). The environmental and economic impacts of the implemented CT options are not measured in a standard way.

#### 3.2. Staffing of NCPCs

The number of staff varies between 1 (Zimbabwe) and 15 (China). Industrial experience and profound knowledge of an industrial sector are definitely an asset for working in an NCPC, particularly in conducting in-plant assessments and providing information on technologies. Only a few larger NCPCs (such as China) can afford to

Table 2  
Key indicators of the progress of the ongoing NCPG Programme (as of 1999)

Country	Start of operation with UNIDO	Number of awareness raising seminars and activities		Number of persons participating in receiving training		Number of persons receiving training		Number of trained CP assessors		Number of plants submitted to in-depth CP assessments		Number of plants w. implemented EMS systems with NCPG assistance		Number of applications for investment to financial institutions		Number of submitted and accepted projects		Number of requests or technical information	
		Cum. Incl. 1999	1999	Cum. Incl. 1999	1999	Cum. Incl. 1999	1999	Cum. Incl. 1999	Cum. Incl. 1998 <sup>a</sup>	1999	Cum. Incl. 1999	1999	Cum. Incl. 1999	Cum. Incl. 1999	1999	Cum. Incl. 1999	Cum. Incl. 1999	1999	Cum. Incl. 1999
Brazil	July 1995	22	7	1461	517	1319	414	43	n.a.	52	24	3	1	22	8	11	6	0	0
China	June 1995	104	8	15,580	1180	741	275	350	n.a.	130	20	10	6	14	4	10	2	n.a.	10
Costa Rica	December 1998	4	4	107	107	10	10	n.a.	n.a.	0	0	0	0	0	0	0	0	10	10
Czech Republic	November 1994	100	20	1000	150	450	52	303	n.a.	125	17	12	5	22	5	12	4	100	25
El Salvador	January 1999	6	6	375	375	8	8	n.a.	n.a.	0	0	0	0	0	0	0	0	0	0
Guatemala	1999	1	1	33	33	9	9	n.a.	n.a.	0	0	0	0	0	0	0	0	8	8
Hungary	May 1997	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	11	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
India	July 1995	89	28	2552	1414	1469	364	65	n.a.	26	8	2	1	15	6	8	4	n.a.	n.a.
Mexico	December 1995	8	2	394	32	557	332	32	n.a.	33	10	0	0	0	1	0	0	100	45
Nicaragua	September 1998	28	8	1373	155	126	9	n.a.	n.a.	22	3	2	0	0	0	0	0	22	7
Slovakia	February 1995	6	6	270	270	154	154	269	n.a.	74	5	7	3	8	8	3	3	56	56
Tanzania	August 1995	8	1	292	50	128	36	n.a.	n.a.	26	8	0	0	0	0	0	0	?	?
Tunisia <sup>b</sup>	January 1996	10	1	400	90	100	25	n.a.	n.a.	28	10	0	0	0	5	0	5	25	4
Viet Nam	July 1998	6	6	282	282	5	5	n.a.	n.a.	0	0	0	0	0	0	0	0	1	1
Zimbabwe	April 1995	3	3	48	48	48	48	11	n.a.	5	5	5	5	5	5	5	5	40+	40+
All NCPGs		389	101	23,897	4703	4970	1741	1079	n.a.	521	110	36	16	78	42	47	29	306+	206+

n.a. = not available. The exact figures in the table above should be taken with some reservations as the centres have used slightly different definitions, i.e. to distinguish between seminars and workshops.

<sup>a</sup> Number of trained CP assessor data only available for eight centres as of July 1998.

<sup>b</sup> Ten of the 28 plants (five electroplating, five foundries) were assessed on a less strict methodology, while four plants (chemical) were assessed in an even deeper format than UNIDO methodology.

employ sectoral specialists. However, in most cases of in-plant assessments, the NCPC staff act as managers, supervisors or organizers of activities conducted actually by consultants. It is primarily the awareness raising, training, dissemination of generic CP information and policy dialogue activities in which the staff are directly involved. Their strong feature is, therefore, good knowledge of the methodology while specialized sectoral expertise is possessed only by some of them. Given the modality of conducting in-plant assessments primarily by consultants, the professional composition of the staff seems to be adequate.

### 3.3. *Awareness raising*

In quantitative terms, awareness-raising activities aimed at disseminating the CP concept have been very extensive (newspaper articles, TV press, newsletters, brochures, handbooks, websites, stands at fairs, etc.). Many of the centres have become recognized as focal points for CP and the CP concept has become well known amongst a set of environmental professionals and within a certain segment of government organizations, municipalities and industry. However, the CP concept has not yet become known or fully understood by all industrial and service companies, but it would be unrealistic to expect such a result from this programme alone, particularly in the more populous countries.

### 3.4. *Technical assistance/demonstration projects*

The interest in the CP programme and the related effective demand for CP advisory services at the company level are rather low. This applies particularly to SMEs. There are a number of reasons for this behaviour. First, for many of them, environmental objectives are not yet truly integrated in the company objectives/strategy partially because of inadequate enforcement of environmental standards. Second, the expected financial benefits that would result from the implementation of the non-investment CT measures may not seem robust enough to deserve staff time and organizational effort required for conducting in-plant assessments. Risks associated with interference in established technologies and processes and time required for identification and elaboration of CT measures may also fend off the company management. Third, the implementation of investment options requires either the use of their own capital, which the SMEs are usually short of, or a loan that, however, is difficult to access for a number of reasons. These include the fact that the amount of loan is not big enough to be of interest for a commercial bank, non-compliance with banks' lending criteria in terms of collateral, financial standing, complicated procedures and strict criteria to access soft loans from the government funds.

There is one more factor that curtails the interest of

both the investor and a financial institution in investing in CT measures. It is difficult to quantify all the economic/financial benefits because they may affect multiple areas, long time horizons and probabilistic nature. In addition to reduction of direct operating costs, CT measures may result in reduction of indirect costs (regulatory compliance costs, pollution control equipment operation costs, etc.), reduction of liability costs (probability of future penalties and fines, etc.) and achievement of less-tangible benefits (safer working environment, corporate image, etc.). Some agencies try to support the decision-making processes for CP investment by elaborating and disseminating the concept of total cost assessment [10] and UNEP has launched a project which also should, *inter alia*, develop instruments to support economic analysis and decision-making on investment [11]. However, the methodological problem of total cost assessment is compounded by the fact that standard accounting systems do not track environmental costs well, so that even the reduction of some operating costs may not be reflected in the accounting system. All these constraints apply and are difficult to overcome particularly in the case of SMEs and CT measures with small size of investment (and an impact not big enough to observe the difference). Potentially, the increasing utilization by enterprises of environmental management accounting will help to overcome some of these difficulties.

When under time pressure to drastically reduce pollution in order to comply with environmental norms, companies very often cannot (or think they cannot) avoid the end-of-pipe treatment of waste. Established consulting companies and suppliers of such waste handling technologies, pursuing their own commercial interests, tend to ignore or marginalize the CP approach. The decision-making at the company level is influenced not only by cost considerations, but also by "easiness" of the end-of-pipe treatment from the management point of view (no need to change production process, trust in established approaches and technologies, etc.). According to one association of industry in a country preparing for EU membership, insistence on rapid implementation of EU environmental standards prompted huge investment in end-of-pipe technologies, which—at least partly—could have been used more efficiently in the rationalization of the technology processes themselves.

### 3.5. *Training*

As explained above, the national capacity to promote and provide CP services is not confined to the NCPC alone, but also includes the mass of expertise and knowledge in the companies and institutions created through awareness raising, training and participation at in-plant assessments. A critical role in the implementation of the CP concept is played by those who become qualified

enough to work as CP assessors and, thus, as active agents of the CP programmes. To achieve this capability, the candidates have to attend the training course and take an active part in a plant assessment.

The number of people trained as CP assessors by the eight NCPCs reviewed under the 1999 evaluation (Brazil, China, Czech Republic, Hungary, India, Mexico, Slovakia and Zimbabwe) was 1079 as of July 1998. The same number compiled through interviews of the NCPC directors in March 1999 amounted to 765 (excluding the five to 6000 participants at training courses of six days duration in China). This discrepancy can be partly explained by the fact that the former estimate may also include those CP assessors who were trained by CP programmes organized by various donors prior to the NCPC establishment. What is, however, more important is the discrepancy between people trained as assessors (765) and the number of assessors who are qualified and experienced enough to actually conduct in-plant assessments (estimated at approximately 200). Some of these people are in industrial companies, some work in institutions and consulting companies, and some work as freelance consultants. (The breakdown depends very much on the country—typically NCPCs hosted by a university or national productivity centre train more staff from those host institutions.) These qualified CP assessors usually work only part-time as CP assessors, either for an in-plant assessment project of the NCPC or in the context of other consulting services. In the latter case, however, the methodology is not necessarily used in its totality.

While it is recognized that CP assessment will most often be used as a complement to other environmental activities, it seems that there is still a potential to make more extensive use of the developed capacity to conduct in-plant assessments. In other words, the demand for in-plant assessment services is below the capacity that is already available. Actually, the services of CP assessors working as freelance consultants are used primarily under CP projects organized by the NCPCs or other donor-funded programmes, which from the point of view of the target companies contain a certain element of subsidy. A spontaneous, commercially driven unfolding of the CP advisory services beyond the NCPCs' control has been rather limited or at least there is little evidence of it. This experience seems to confirm that those who offer CP assessments as fee-paying service will probably not be able to offer them full-time, but rather as a complement to other (mostly legislation-driven) services or to fix specific process related problems as they come up.

There were some allusions that some staff trained as CP assessors only partially apply the methodology when providing related advisory services to industry, such as counselling on EMS. It is also observed that training in CP methodology helps consultants in advising on EMS and its implementation. This fact would not only support

the NCPC strategy to integrate CP with EMS. It would also suggest that making CP an integral part of other advisory services to industry could be one of the effective avenues for a self-sustaining dissemination of the CP concept. In practical terms, it should imply increase in the attention of the NCPCs to consulting companies and freelance consultants when selecting target groups for awareness raising and training activities as well as networking with them for the purpose of delivering complementary services.

### 3.6. *Technical information services*

In most cases, requests for technical information were supply driven in the sense that they were initiated by the NCPC itself in the process of conducting in-plant assessments. The number of spontaneous inquiries from the end-users (companies, institutions and public in general) has been rather limited. The NCPCs do not keep records of such inquiries, but some NCPCs estimate that the number of such inquiries does not exceed 10 per month. The inquiries usually deal with generic aspects of CP. Inquiries about environmentally sound technologies, including end-of-pipe treatment technologies, are not frequent and inquiries about specific CT options are actually very rare.

Low demand for this type of information reflects itself in the very limited development of capabilities at the NCPC to provide such services. Databases at the NCPC, where they are developed and operational, serve rather NCPC management than external users. Some databases taken over (such as International Cleaner Production Information Clearinghouse (ICPIC) from UNEP) were installed and in some cases (Hungary) even translated but their use is negligible. The capability to perform a referral service is also not well developed; hardly any NCPC has a list of useful websites to refer to when looking for information. Internet is used usually for the NCPC's own information needs and again, these needs only occasionally deal with specific technologies. Also, international experts provided by the UNIDO/UNEP programme and UNEP's expert groups have hardly been used as sources of information on technology. Most of the international experts are considered as competent in providing methodological advice, but not in terms of specific (sectoral) expertise.

Some NCPCs have a staff member trained and experienced in searching on the Internet and this person then carries out the search for other NCPC staff. However, some NCPCs still report technical problems in connectivity (low capacity, long waiting time, etc.). Low demand for information on technologies by external clients is to a great extent understandable. Large companies have their own mechanisms, professionals and established channels to keep abreast of the state-of-the-art technologies. SMEs, on the other hand, are in most cases

not aware of what information they may need and therefore, they do not ask for it. The second dimension of the problem is that the information available in the databases on the Internet and elsewhere is often of little practical use for SMEs if not accompanied by advice/expertise. Technical information is a powerful tool in the hands of the expert who knows how to interpret it and apply it in a certain context, whereas information on technology accessed through a library, the Internet, or a patent office in the hands of laymen is of limited value. If SMEs do need some information on technology, they usually contact somebody they know in the business and whom they trust, or a dealer or manufacturer/supplier of equipment.

It seems that the frequently emphasized importance of information for technology change including transfer of technology needs some qualification. Simple dissemination of information on technology among SMEs would not help much. What is more effective is dissemination of information in the context of business advisory services. In view of this, the NCPCs need not set too ambitious goals as regards dissemination of stand-alone information on technology. Rather, they should aim at developing a capability to provide expert advice (supported by updated technical information). Such expertise, however, requires continuous exposure to the specific technology area, visiting trade fairs, following up professional literature etc. As it is hardly possible to staff the NCPC with such experts covering all sectors, it is necessary either to focus on a specific sector of industry or—what seems to be more practical—to establish a network with other sectoral institutions, consulting companies or freelance consultants to whom such services can be subcontracted or referred to. This is yet another reason why these groups should be targeted in training and awareness raising activities.

### 3.7. *Financial advisory services*

So far only a few NCPCs have tried to address the problem of access to financing for implementation of the investment options. Some of them (such as the Czech centre) were instrumental in promoting and establishing such financing facilities or in cooperating with them in evaluating applications for soft loans (Tunisia). As access to financing is one of the key factors of CP implementation, this field is becoming more and more important for the NCPCs and a number of them plan to enter into this field. It will require their close cooperation with the banking system and the government authorities; participation of bankers at the CP training courses or in the final stages of in-plant assessments can support such cooperation. As financing of CP options has some specific features, this is apparently one of the fields in which the UNIDO and UNEP headquarters can play a significant role in providing methodological advice to the NCPCs, in organizing an intensive and continuous

exchange of experience among them and in mobilizing bilateral and multilateral investment funds to support NCPC's activities at the industry level. The UNEP CP financing project mentioned earlier plays a special role, in which five NCPCs participate. Their experience as well as the instruments designed by the project could be used by all NCPCs in providing financial advisory services.

### 3.8. *Policy advice*

Given the increasing importance of environmental protection among the policy objectives of governments and sufficient evidence provided by the CP programmes that it is possible to reconcile environmental and economic objectives, the demand at policy level for CP programmes has been considerable. This is reflected not only in government interest in and political support for donor-funded technical cooperation programmes in this field, but also in policy measures adopted by some governments to support dissemination of the concept and implementation of CT measures by enterprises. For example, the Czech Ministry of Environment included CT among those measures that are eligible for a subsidy from the State Environment Fund. Companies implementing CT measures/projects are eligible to apply for a subsidized (soft) loan up to 70% of the required investment (with the upper limit of US\$ 1 million per loan).

At the same time, however, the budgetary constraints in most developing countries and countries in transition do not allow them to back the CP concept by allocation of resources large enough to carry out promotional and other dissemination activities. It is only in some countries (such as India) that the government allocates distinct budgetary resources to finance promotion and dissemination of the programme. Thus, in most countries, local ownership of the CP dissemination programmes (demonstrated by financial commitments) is difficult to achieve and the role of external (donor) funding remains essential. To a great extent, this "supply driven" component in the CP programmes reflects the differences in actual policy priorities between the developed and developing countries.

## 4. *Sustainability*

As explained above, the long-term goal of the programme is the widespread application of the CP approach in industry. NCPCs are one of the tools. Once the ultimate goal is achieved, there will be no need for the NCPCs. However, this is a perspective reaching far beyond the lifetime of the UNIDO/UNEP programme support to individual NCPCs (three to five years). Hence,

in the medium-term (three to ten years), the sustainability of the NCPCs is a real issue.

In practical terms, the issue of sustainability boils down to financial sustainability (cost recovery)!! Once the UNIDO financial support is over, there are in principle three potential sources of NCPC financing: contribution in cash or kind by the host organization (if there is any), income from services to local clients (industry, the Government) and income from implementation of CP projects funded by other donors. Except for government support through the host organization, if in public sector, direct Government subsidy to the centres seems to be only a theoretical possibility at present.

Even though it is difficult to get a clear picture about the current level of cost recovery by NCPC programme components, it is clear that without external support (by foreign donors), the NCPCs could hardly survive. Those NCPCs, which are likely to sustain their operations after completion of the UNIDO financial support (China, India, Brazil, Mexico, Slovakia, the Czech centre, Zimbabwe, Tanzania etc.), either enjoy support of the host institution or have managed to access other external funding sources (usually other CP programmes). Some of them earn some income on services sold to the government when supporting them in the design and implementation of their environmental programmes.

There is a general trend to commercialize the services of service institutions and this trend is frequently applied to the NCPCs as well. It is, however, hardly possible for the NCPCs to sustain on income generated from CP advisory services to industry alone. Furthermore, the policy of maximizing income from the direct advisory services to industry would run counter to the purpose of the programme. The primary purpose of the NCPC is not to provide CP advisory services to industry but rather to play a pivotal role in implanting the CP concept in existing advisory services carried out by other organizations and consulting companies. Such an approach contributes best to the dissemination of the concept, complies well with the staff qualifications and professional capabilities and, at the same time, minimizes distortion in the market of consulting services.

To play such a pivotal role, the NCPCs must sustain their capability to act as centres of excellence in this field by deepening their direct experience from in-plant assessments under different conditions and by extending networking with potential partners in CP applications. For playing such a non-commercial (public service) role, the NCPCs hosted by a well-established organization (either government or NGO) may be in an advantageous position compared to the status of being an independent entity, which tends to focus on commercial activities. This, however, applies only on the condition that the host organization identifies itself with the mission of the NCPC and does not consider it as potential source of income for the host organization, as some experience

suggests. On the other hand, too close an identification of the NCPC with a government institution may jeopardize its credibility in the eyes of industry.

As there is no standard solution for the status of NCPCs after project completion, it also depends on the management and staff of the NCPCs themselves to what degree they manage to develop contacts with different stakeholders and establish themselves in the “market” for CP programmes and advisory services. The importance of this issue has been fully recognized in the NCPC programme as evident from the emphasis laid on and methodological support provided for preparation of business plans in each NCPC.

## 5. Conclusions and lessons learned

CP is a cost-effective approach towards sustainable development. The UNIDO/UNEP NCPC programme confirms that the CP methodology is an effective tool for identification and prioritisation of technology changes that yield both environmental and economic benefits. This applies particularly to existing production or service facilities. (Other tools, such as environmental impact assessment and life cycle analysis, address the environmental dimension of new investment projects.) In some cases, the proposals for technological changes generated under the programme were based on generic rationalization principles without application of the CP methodology. This indicates the affinity of the underlying principles of the CP methodology as applied by the NCPCs to the generic rationalization approaches used in production management.

However, the programme has also confirmed that dissemination and application of the CP concept among SMEs on the basis of its own economic merits does not occur easily, so there is a need to support the dissemination of the concept through promotional (awareness raising and training) activities and policy measures. Developing local capacity to promote CP takes time because hands-on experience and a certain minimum number of success stories need to be available. Furthermore, local ownership of the CP dissemination programmes (demonstrated by financial commitments) is difficult to achieve so that the role of external (donor) funding remains essential. To a great extent, the constraints of local funding and availability of donor funding reflect the differences in actual policy priorities between the developed and developing countries and their capability to support environmental policy objectives by appropriate budget allocations.

### 5.1. Impact

The programme has contributed to the dissemination and application of the CP concept in the countries sup-

ported by the programme. Its effectiveness can be observed mainly in awareness raising, training of CP assessors, and introduction of the CP concept in curricula of educational institutions and, in some countries, integration of CP into the environmental policy framework. Actual impact in terms of environmental and economic benefits at the industry level has been rather modest compared to the potential which exists in the whole industrial sector and this impact has been achieved primarily through in-plant assessments conducted or organized by NCPCs themselves. There is only limited evidence of an impact at industry level, which could be ascribed to the activities of NCPC-trained CP assessors carried out beyond the control of NCPCs or through any other spin-off activities.

### 5.2. Transfer of technology

Given the constraints identified earlier (such as limited access to financing) and some intrinsic features of management decisions (the easiest to implement are the non-investment changes in housekeeping), the technological changes induced by the programme are primarily in the lower order of complexity and investment so that most of the implemented changes are not spectacular. This is compounded by the fact that majority of the companies supported by the programme are SMEs.

### 5.3. Management dimension

While the core methodology of the CP is technical, its application within a company is a function of its management. Therefore, the success at company level depends not only on the technical and communication capability of the CP assessors but also on the level of management in the company. The NCPCs have two options for addressing this problem. One is to provide support in conducting in-plant assessments on selective basis only to companies with good management (as reflected in company performance indicators, established systems of quality management, integration of environmental objectives in the company strategy, etc.). Companies certified or preparing for ISO 9000 or EMS would be the best candidates. The other is to complementing the CP advisory services by other management advisory services (quality management, production management, etc.). The latter option is more difficult and represents a complex task that could stretch the NCPC services too broadly; alternatively, cooperation with other consultancy services may help.

### 5.4. Upgrading methodology

On the supply side (delivery of advisory services), the NCPCs need to continue upgrading the professional level of their advisory services to industry by strengthen-

ing their sectoral expertise (or, more probably their access to sectoral expertise) and elaborating further the CP methodology and its application. Further elaboration of the methodology could include elaboration of sector—or process specific methodologies with compilation of selected parameters for benchmarking purposes. This should be harmonized with the contents of the database of technical reports. Enhanced application of the methodology should also include active mastering of selected measuring instruments and techniques. In addition to this rather technical upgrading of the methodology itself, it is also necessary to continue elaborating principles for its application in the context of company management (integration with EMS but also industrial management in general) and in relation to other tools aiming at sustainable production (such as life cycle analysis and environmental management accounting). No doubt such activities will require cooperation with other stakeholders, including universities and international advisors.

### 5.5. Public service vs. commercial activities

The activities of the NCPCs should continue to be a mixture of income generating advisory services and subsidized public service (focal point) functions which, in addition to awareness raising, policy dialogue, etc. should include the above mentioned elaboration of the methodology and approaches for its application as well as compilation of and mastering of access to information resources. The shares of these two categories of activities (commercial consulting and public service) cannot be standardized as they depend on the specific conditions of each country, but the focal point function should dominate. As a rule, the more advanced and competitive the management consulting services in the country are, the easier it should be to transfer gradually the commercial application of the CP advisory services to them, while retaining and upgrading the public service (focal point) functions. Consulting companies in the fields of quality management (ISO, TQM, EMS, etc.) and pollution control (end-of-pipe technologies) are the most suitable candidates to integrate CP in their services, but there may be other service providers who can integrate CP into their advisory services, such as R&D institutions and universities.

In view of the above, the NCPCs should not be evaluated exclusively or primarily by impact at the company level, which results from in-plant assessments organized by the NCPCs themselves. Rather they should be evaluated primarily by the impact at the industry level in terms of their successfully transferring the CP concept and its tools to other organizations/consultants and their contributing to the formulation of a conductive CP policy framework.

### 5.6. Main lessons learned

The above findings suggest that:

- The diffusion of the CP concept can hardly unfold on commercial principles, particularly among the SMEs, so that some element of promotion/subsidy is needed;
- the promotion of the concept under the programme needs to focus on factors creating demand (awareness raising, policy framework, access to finance);
- the access to finance is the critical factor for implementing more complex technology changes (usually through transfer of technology) and achieving significant economic and environmental impact;
- to become a continuous process in the company, CP needs to be integrated in EMS;
- therefore, the main target group for CP should be companies introducing or planning to introduce ISO 9000, EMS, ISO 14000 or Corporate Social Responsibility Programmes, i.e. the more advanced segment of the SMEs particularly those receiving foreign capital. For the purpose of visibility and creating a body of references, large companies could be among the clients as well; and
- a certain level of management and financial stability should be a prerequisite for any intervention. Complementing CP advisory services or integrating them with other management advisory services could overcome this problem.

The preceding conclusions imply that the NCPC programme has better chances of achieving significant impact in countries that have a larger segment of well performing industry with consolidated management systems than in countries in which large segments of indus-

try face rudimentary problems of survival and are in need of restructuring and consolidating management functions first. It is particularly in such countries that the CP programmes should cooperate closely or be integrated with other management consulting services in providing advisory services to industry.

### References

- [1] UN, Department of Public Information. Agenda 21, Section 34.14. 1997.
- [2] UN. Report of the World Summit on Sustainable Development, Johannesburg, South Africa, New York (available on [www.johannesburgsummit.org](http://www.johannesburgsummit.org)) 2002.
- [3] UNIDO. In-Depth Evaluation of Selected UNIDO Activities on Development and Transfer of Technology, The UNIDO/UNEP National Cleaner Production Centres (NCPCs), Component 1, ODG/R.11, 1999.
- [4] UNIDO. Evaluation of the National Cleaner Production Centres in Central Europe, ORG/R.22–25, Four volumes, 2001.
- [5] Kisch P, Rydén E, Lindhqvist T. Evaluation of the UNIDO/UNEP National Cleaner Production Centre Programme, International Institute for Industrial Environmental Economics at Lund University, 1996.
- [6] Grütter J. Comparative analysis of cleaner production centers. Swiss Federal Office of Foreign Economic Affairs, 1998.
- [7] Muchie M. Old wine in new bottles: a critical exploration of the UN's conceptions and mechanisms for the transfer of environmentally sound technologies to industry. *Technology in Society* 2000;22:201–20.
- [8] UNEP. Learning from the Experience of National Cleaner Production Centres, Division of Technology, Industry and Economics, 2002.
- [9] UNIDO. In: Proceedings of the Conference on Ecological Sustainable Industrial Development, Copenhagen, vol. 8. 1991. p. 44a.
- [10] US Environmental Protection Agency. Facility Pollution Prevention Guide. EPA/600/R-92/088, 1992.
- [11] UNEP. Finance Initiative <http://unepfi.net/ebulletin>.