

National Cleaner Production Centres 20 years of achievement

Towards decoupling resource use and environmental
impact from manufacturing growth



UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION



UNITED NATIONS
ENVIRONMENT PROGRAMME

ACKNOWLEDGEMENT

This publication builds upon the collective experiences and knowledges of the National Cleaner Production Centres and their international development and national industry and government partners, including in particular the United Nations Industrial Development Organization (UNIDO), the United Nations Environment Programme (UNEP) and their service providers and associated international and national experts. The NCPCs would not have been possible without the financial support of the donor group, comprising since the launch of the programme in particular: Switzerland, Austria, the Czech Republic, France, Germany, Italy, Japan, The Netherlands, Norway, Slovenia as well as to European Union, Global Environment Facility, One UN Funds, United Nations Development Programme and the countries which provided self-financing: Brazil, Republic of Korea and Russia.

This publication was drafted by René Van Berkel, with extended inputs from present and past UNIDO staff, particularly Smail Alhilali, Permod Gupta, Heinz Leuenberger, Skip Luken and Petra Schwager, under the direction of Stephan Sicars. The publication benefitted significantly from further review and additional suggestions of Desta Mebratu and Elisa Tonda (both UNEP), and Vladimir Dobes, Jack Luskin, Jane Nyakang'o and Frans Verspeek, long term experts in the NCPC programme.

This publication may be reproduced in whole or in part and in any form for educational or non-profit purposes without specific permission from the copyright holder, provided acknowledgement of the source is made. UNIDO would appreciate receiving a copy of any publication that uses this publication as a source.

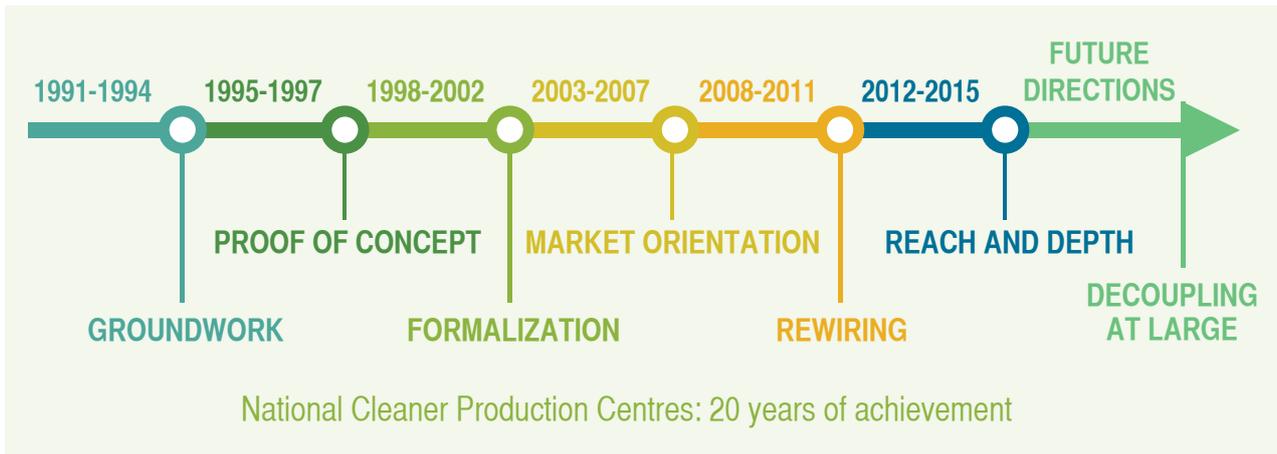
No use of this publication may be made for resale or for any other commercial purpose whatsoever without permission in writing from the United Nations Industrial Development Organization.

Version 1: October 2015

Copyright © United Nations Industrial Development Organization

DISCLAIMER

This document has been produced without formal United Nations editing. The designations employed and the presentation of the material in this publication do not imply the expression of any opinion whatsoever on the part of the Secretariat of the United Nations Industrial Development Organization (UNIDO) and/or United Nations Environment Programme (UNEP) concerning the legal status of any country, territory, city or area or of its authorities, or concerning delimitation of its frontiers or boundaries or its economic system or degree of development. Designations such as 'developed', 'industrialized' and 'developing' are intended for statistical convenience and do not necessarily express a judgement about the stage reached by a particular country or areas in the development process. Moreover, the views expressed do not necessary represent the decision of the stated policy of the United Nations Industrial Development Organization and/or the United Nations Environment Programme, nor does citing of firm or trade names or commercial processes constitute endorsement by UNIDO and/or UNEP.



INTRODUCTION AND OVERVIEW

The idea is simple: preventing the generation of waste and emissions in industry does make more sense than trying to recycle, recover and treat wastes and pollutants once created or already discharged into the environment. From the mid 1980's onward industrialized countries, starting from North America and Western Europe, launched programs to demonstrate this preventive approach in manufacturing and related sectors. Early experiences revealed numerous opportunities for win-win solutions: enterprises reported cost savings from preventing pollution. Different terms and concepts emerged to capture basically the same idea, including pollution prevention, waste minimization, waste prevention, toxics use reduction, clean technology, and later integrated pollution prevention and control. The turn of the 1990s saw cleaner production emerge as an umbrella term. Against the background of the preparations for the 1992 United Nations Conference on Environment and Development (Rio Conference), the realization came that if manufacturing goes global, cleaner production should follow suit as a global undertaking.

Several development partners, including the United Nations Industrial Development Organization (UNIDO) and the United Nations Environment Programme (UNEP), set out to first demonstrate the applicability of cleaner production and related methods and techniques in developing and transition countries, including: China, India, Poland, Czechoslovakia and elsewhere. By mid-1990's these initiatives had convincingly demonstrated that cleaner production is at least equally applicable and beneficial in these developing and transition countries as it had been in industrialized countries. The further adaptation and wider adoption of cleaner production, though, required national capacity and expertise. The concept of National Cleaner Production Centres (NCPCs) was born.

The first eight NCPCs opened their doors in 1995. Their achievements sparked global interest: additional NCPCs were established, with the support of UNIDO and UNEP in up to 58 countries by 2015, and further comparable initiatives by other development partners in even more countries. Collectively NCPCs established important regional knowledge networks, and enabled international initiatives, including for example the development of 10 Year Framework of Programmes (10YFP) on Sustainable Consumption and Production (SCP). 2015 hence marks two decennia of achievements by NCPCs!

Times have changed, and so have the NCPCs. The need to clean up polluting industries in developing and transition countries has remained pertinent. Yet, industries equally need to sharply cut their emissions of greenhouse gases (GHG), adapt to likely changes in the climate and make sure that all natural resources are used productively and chemicals are produced, used and managed in safe and responsible manners. In response, Cleaner Production became Resource Efficient and Cleaner Production (RECP) as the same preventive methods and techniques deliver these multiple environment, energy and resource conservation benefits in a business-oriented fashion. The service portfolios of NCPCs expanded, to include amongst others support in policy development and implementation, technology transfer and financing, in addition to enterprise advisory services that remained at the core of the NCPC. A single NCPC cannot alone change the course of industrial development in the country, demonstrating the need for multiple partnerships

and networks with business, government and civil society, within the country, at regional level and globally. Regional roundtables and other knowledge platforms were established. More emphasis was placed on institutionalization, governance and professionalization of NCPCs to step up to the growing demands and expanding expectations.

20 years is a milestone worth reflecting. Using a reconstructed timeline, this paper summarizes significant developments and responses by the community of NCPCs, their national counterparts and development partners. This report does not claim, nor even aspire, to be comprehensive in summing up achievements of the NCPCs individually or collectively. Such is fundamentally impossible, given that NCPCs have worked as catalysts and provided platforms for initiatives of others, including their national governments and business sectors and other development partners. Instead, it is aimed to demonstrate the evolution of the NCPC concept, the vibrancy of the activities of NCPCs and their fellow network members, the relevance of their achievements in the changed and changing international development agenda and their readiness to lead change towards decoupling of economic development from the increased use of natural resources and worsening pollution, in particular in the manufacturing sector.



CONTEXT

In the mid-1980s regulators and environmentalists alike realized that even though avoidance and prevention were established priorities in environmental policy and legislation, such did not translate into widespread uptake of preventive measures. Technical assistance programmes were launched to support industries by identifying preventive opportunities initially in leading States in the USA (e.g. California, North Carolina, Massachusetts and Minnesota) and later several Western European countries (Sweden, The Netherlands, Austria and others). Their success catalyzed renewed global interest and at the 1991 UNEP conference on preventive environmental management practices in Canterbury, UK, the term cleaner production was coined and endorsed for global application. The ideas were further developed during the 1991 UNIDO Conference on Ecologically Sustainable Industrial Development organized in preparation for the 1992 Earth Summit in Rio. Agenda 21 adopted at the Rio summit included multiple commitments for developed countries to assist developing and transition countries to access environmentally sound technologies and know how, including those for preventive environmental management.

INITIATIVES

UNEP and UNIDO had jointly elaborated and published in 1990 the Audit and Reduction Manual for Industrial Wastes and Emissions to start focusing on opportunities for developing countries. Apart from being a technical resource, the publication sealed cooperation between the two United Nations institutions sending a clear signal that cleaner production was both desirable and necessary from environment and industrial development perspectives.

In response to countries' requests a first generation of loosely coordinated demonstrations was conducted by different development partners. For example, UNIDO conducted the DESIRE project in India, UNEP jointly with World Bank delivered the first cleaner production technical assistance programme in China, the United States Agency for International Development (USAID) started the roll out of its environmental pollution prevention projects (EP3) from 1993 in Tunisia (and later on in eight other developing countries), Norway supported cleaner production focused management training for engineers initially in Poland (and later other central European countries) and World Environment Centre (WEC) set out to establish pollution prevention centres in nine central and eastern European countries. Despite their differences in methodology and delivery model, each of these pioneering initiatives combined elements of national capacity building with actual demonstrations in selected industries.

Initial results and experiences were discussed at UNEP's biennial high-level cleaner production meetings. At the third of such Meetings, held in Warsaw in October 1994, UNIDO and UNEP formally announced their joint programme to establish National Cleaner Production Centres (NCPCs).

INSIGHTS

Developing country firms participating in the first round of cleaner production demonstrations succeeded to identify and implement customized measures that brought them cost savings and reduced their environmental impact. Collectively the demonstration projects thereby provided testimony that cleaner production concepts and methods can be beneficially applied in developing and emerging economies. Moreover, individually, these country demonstrations shed light on specific elements, such as customization of concepts and methodologies (e.g. in India), role of cleaner production in implementation and enforcement of existing environmental policy (e.g. China) and need for capacity building of experts, company staff and regulators.

In light of the challenges observed in developing country firms, further uptake of cleaner production was found to be contingent on such firms having easy access to technical assistance to identify, evaluate and promote company specific cleaner production solutions. The concept of National Cleaner Production Centre (NCPC) was developed in response. It was anticipated that such NCPCs would disseminate information and raise awareness, provide training for national experts and conduct in-plant cleaner production assessments in national industries.

ILLUSTRATIONS

// In India, UNIDO implemented the DEMonstrations in Small Industries for Reducing wastE (DESIRE), during 1993-1994. The project included waste minimization assessments in 12 companies from textile wet processing, pulp and paper and pesticides formulation sectors. DESIRE also developed and first published waste minimization guidelines for small industries, a methodology that gained further recognition in particular in the Asia Pacific region as Success in Six, respectively: Getting Organized; Analyzing Process Steps; Generating Waste Minimization Opportunities; Selecting Waste Minimization Solutions; Implementing Waste Minimization Solutions; and Sustaining Waste Minimization. The methodology was presented in a generic primer as well as further expanded into sector specific technical manuals. A total of 540 opportunities were identified, of which 38% were implemented at completion of the project. The net annual savings from the first 196 implemented options in 11 companies had been USD 937,350 with investments of USD 421,200, all from options with pay-back periods of 6 months or even less. A follow-up survey after three years in five of the firms confirmed continuation of the cleaner production initiatives in all companies, doubling their total number of implemented options whilst also identifying new waste minimization opportunities. The total investment in waste minimization solutions in these enterprises increased 5.6-fold in the first 3 years after completion of the assessments, resulting in a 3.8-fold increase in annual savings.

// In China, within the framework of an Environmental Technical Assistance project of the World Bank, UNEP executed between 1993 and 1995 cleaner production demonstrations in close cooperation with the then State Environmental Protection Authority and selected provincial and municipal environmental protection bureaus. 29 cleaner production audits were executed for 27 companies facilitated by staff of the responsible environmental authorities. The no/low-cost options identified and implemented generated annual economic savings of approximately USD 2.9 million with a total investment of less than USD 100,000. These reduced targeted waste streams typically by 20-30 percent, yet in some cases higher. A further 59 equipment upgrades were identified that required a total investment of approximately USD 205 million, with economic benefits worth approximately USD 215 million in net present value over the lifetime of

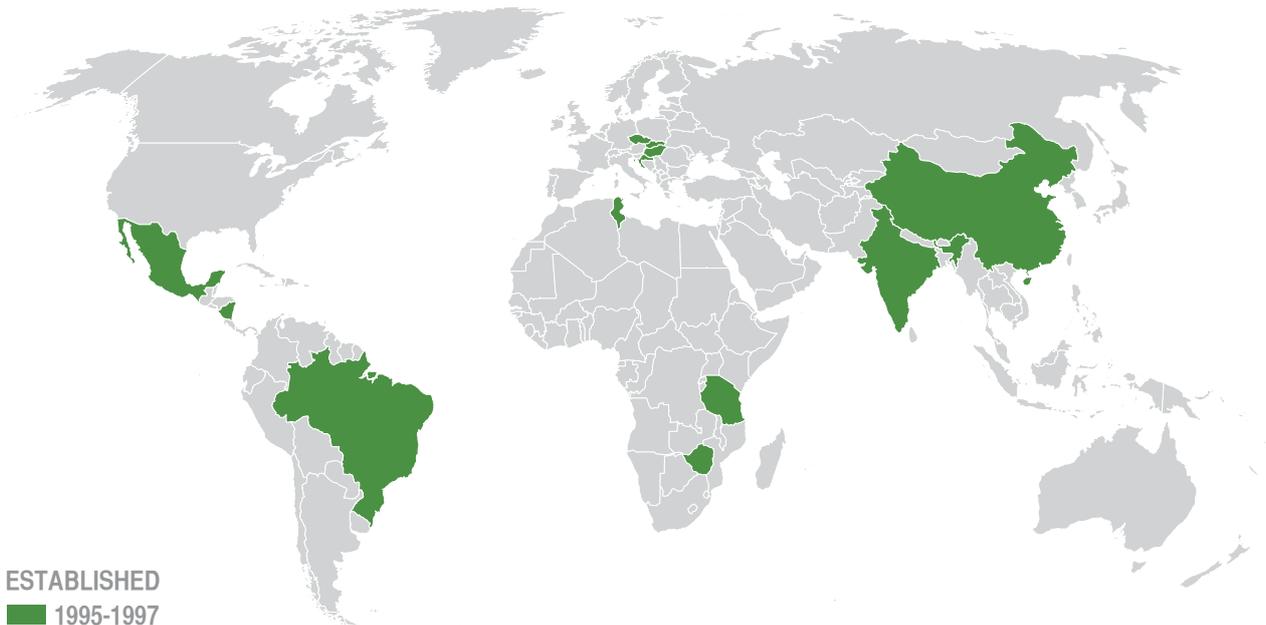
these investments. Moreover, cleaner production audit guidelines were developed, based on adoption of the joint UNEP UNIDO Waste and Emission Audit and Reduction Manual. These continued to provide a benchmark for developing certified cleaner production audit training and for the mandatory audit provisions in the 2001 China Cleaner Production Promotion Law.

// The Norwegian Society for Chartered Engineers designed a cleaner production training and coaching programme tailored to technical managers of industries in post-Soviet Eastern Europe. The programme was first trialed in Poland, jointly with the Polish engineering society. By 1994, 150 manufacturing enterprises from 20 sectors had benefitted and demonstrated that 20-40% reduction of waste and pollution was possible with nil or minor investments, and a further 30% reduction would be possible with profitable investments in cleaner technologies. Average investments made by companies mounted up to USD 67,000 delivering average USD 351,000 annual savings. In the Czech Republic, 46 companies benefitted between 1992 and 1996 from a similar programme, achieving total annual benefits of USD 7 million. Interestingly it was found that on average the participating companies were saving 12 USD on internal costs (energy, labor, materials) for every USD saved in reduction of waste disposal costs. Based on these experiences in Central Europe, the Organization for Economic Cooperation and Development (OECD) developed and promoted until 2001 the idea of basic cleaner production capacity for the transitional countries including: information and awareness raising, professional training and in-plant demonstrations.

// USAID coordinated the implementation of the Environmental Pollution Prevention Programme (EP3). EP3 provided technical assistance (plant level pollution prevention assessments and technology transfer through demonstration projects and facilitating access to investment); training and outreach (for government, industry, non-governmental organizations, consultants and academia) and supported policy development (in pollution prevention area). Consecutive three year support was provided to Tunisia and Chili (from 1993) and thereafter to Bolivia, Ecuador, Egypt, Indonesia, Jamaica, Mexico and Paraguay. By the end of the project in 1999, up to 300 pollution prevention assessments had been conducted in particular in toxics-intensive sectors such as lead acid battery smelting, printing, electroplating, leather tanning and textile wet processing, with implementation rate for recommended options varying between 25 and 50%. EP3 found that working with groups of plants, small and large, instead of one plant at a time, led to higher implementation rates, whereas in addition industry needs were better met by providing comprehensive solutions, including no/low-cost process efficiency options, new technology, environmental management systems and access to financing. EP3 was successful in creating a cadre of professionals and working with selected plants, yet less effective in engaging government or scaling to sectors.



Effluent treatment India



NCPC Countries: Brazil, China, Croatia, Czech Republic, Hungary, India, Mexico, Nicaragua, Slovakia, Tanzania, Tunisia and Zimbabwe.

CONTEXT

Governments and other stakeholders that had set out enthusiastically to implement pilot activities in support of Agenda 21, realized such pilots were insufficient to operationalize and implement sustainable development. Standardization was embraced by some and the international environmental management system standard was released by the international organization for standardization (ISO14001). In parallel, climate change gradually became a global concern, and a first agreement on emission reductions was arrived at during the Kyoto climate conference in December 1997.

INITIATIVES

UNIDO and UNEP kicked off the establishment of the first batch of NCPCs. Deploying a lean model, NCPCs were set up as small units within existing institutions ('host organizations') that were directed to promote cleaner production, strengthen technical capacity and undertake cleaner production assessments. Whilst having independence and autonomy, each NCPC was supported by, or even notionally 'twinned' with, established partner cleaner production institutions in industrialized countries providing them technical and management support, including training and coaching and guiding demonstration activities. Annual directors' meetings were called to discuss results and experiences, among key NCPC staff, representatives of the international partners and programme management. NCPCs started individually to document and disseminate cleaner production successes with their national counterparts, and thereby sought to get cleaner production on the agenda of business and government alike. Moreover, within their respective regions, NCPCs contributed to the regional cleaner production roundtables as these were set up for Europe (1994) and the Asia Pacific (1997).

INSIGHTS

The NCPCs started their operations in the project-mode that had proven successful in earlier period and focused on cleaner production demonstrations in national industries along with capacity building and industry outreach. These demonstrations provided renewed and extended evidence from new countries and new sectors that cleaner production is applicable in and beneficial for small-scale industries in developing and transition countries. Results and experiences were documented and disseminated in different ways by NCPCs in their home countries reflecting experimentation across countries.

North South knowledge transfer was achieved as the first batch of NCPCs was able to benefit from the technical and related expertise of the initial set of partner institutions from Austria, Denmark, The Netherlands and USA, covering aspects of training and capacity building, assessment methodology, policy and sector knowledge. Annual directors' meetings brought together NCPCs, partner institutions and UN agencies, and the relatively small scale and highly interactive nature of these meetings achieved experiential learning and the building of a community of practitioners, and indeed set the stage for triangular, South-North-South knowledge collaboration that remained a trademark feature of the NCPC-initiative until today.

First attempts of NCPCs to engage with their governments resulted in additional cleaner production initiatives, such as for example for Waste Minimization Circles in India and standardization of cleaner production training in China. Overall though, it was realized that policy change in support of cleaner production required long-term engagement and cooperation with government and business sectors. UNEP launched in 1997 its first manual on sustainable product development to assist NCPCs and other partners with extending cleaner production initiatives towards design and development of consumer goods.

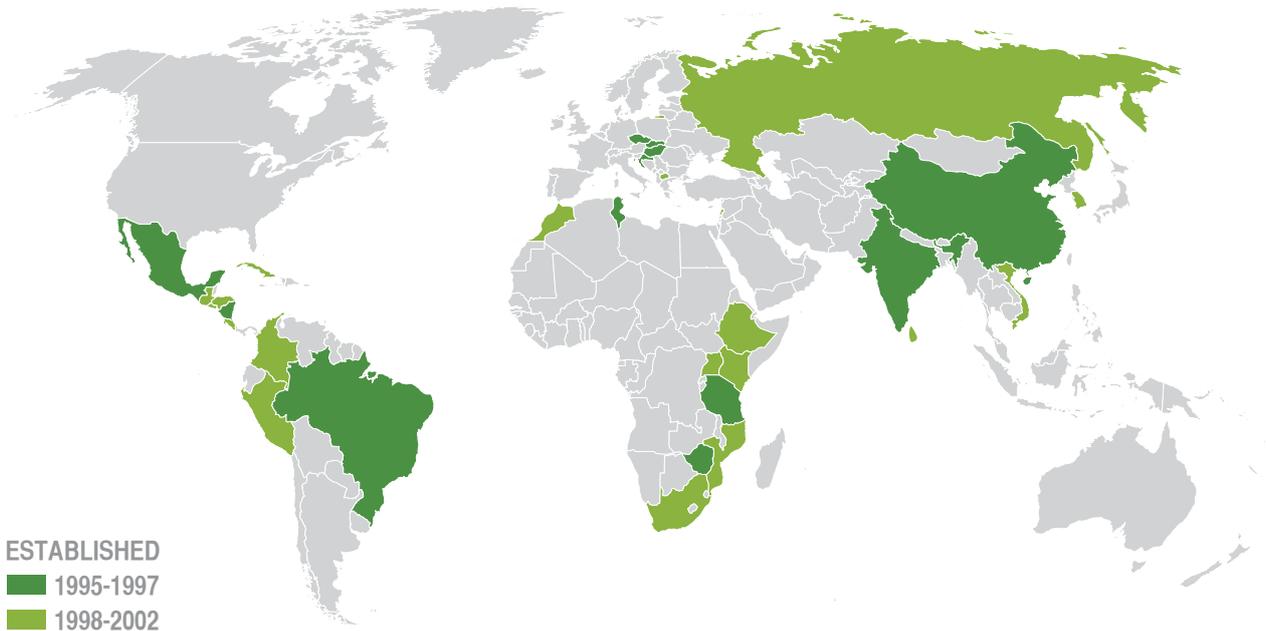
ILLUSTRATIONS

// In Zimbabwe the NCPC was initiated from late 1994 by the Environmental Forum of Zimbabwe (EFZ), a grouping of environmentally aware businesses, which used the Scientific and Industrial Research and Development Centre (SIRDC) as technical support. By 1998, 19 assessments had been completed with the support of twinning institutions from The Netherlands (IVAM Environmental Research) and Denmark (Danish Technological Institute). Demonstrations covered brewing, sugar refining, meat processing, fruit canning, foundry, soap manufacturing, chemicals, metal finishing, leather tanning, glass manufacturing, pulp & paper, textiles, and timber and wood processing, covering a mix of SMEs and larger scale operations. Appreciation for the cleaner production concept was high, and so was the appreciation of the benefits brought about by the implemented no- and low-costs options. Yet no investments were made for higher-cost options due to lack of technology and management commitment and access to and high cost of capital.

// In Mexico, the NCPC undertook in 1997 a demonstration project with seven foundries in the city of San Luis Potosi, Mexico. A total of 103 cleaner production opportunities was identified, representing some USD 80,000 in savings, primarily in energy and materials use. 42% of options were implemented at the end of the demonstration project, with a further 36% of options considered feasible and agreed for implementation by the respective companies. Several outreach activities were organized and a technical manual produced to support uptake of cleaner production options by other foundries in the country.

// Working with the respective NCPCs, STENUM, one of the Austrian technical counterparts, supported the first overseas pilots with the adaptation and adoption of the Austrian EcoProfit Programme in Czech Republic, Slovak Republic and Brazil, during 1994-1998. It was found that the model of supporting small and medium sized enterprises in locally or regionally organized groups could also be deployed in transition and developing countries. These and alike examples of group- or cluster-based cleaner production support through for example Cleaner Production Clubs (South Africa) and Waste Minimization Circles (India) continue to guide efforts to scale-up methodologies for cleaner production implementation among small and micro-enterprises.

// Inspired by the success of the US National Pollution Prevention Roundtable, the first European Cleaner Production Roundtable was held in Graz, Austria, immediately following the official announcement of the NCPC programme in 1994. The first Asia Pacific Cleaner Production Roundtable was held in Bangkok, Thailand in 1997 back-to-back with the third global meeting of NCPC directors.



New NCPC Countries: Colombia, Costa Rica, Cuba, El Salvador, Ethiopia, Guatemala, Honduras, Kenya, Lebanon, Macedonia, Morocco, Mozambique, Peru, Republic of Korea, Russian Federation, South Africa, Sri Lanka, Uganda and Vietnam.

CONTEXT

Recognizing the need for renewed government commitment to cleaner production, UNEP initiated and launched in 1998 the International Cleaner Production Declaration, a statement of commitment with suggested actions for government, business and other sectors to promote cleaner production. The Millennium Development Goals (MDG) were developed and agreed upon during the Millennium Summit in 2000 to provide a 15 year international development agenda that included strong commitments to environment, water and sanitation. Business, civil society and science and innovation sectors started to lead the way towards sustainable development, resulting amongst others in greater emphasis on consumption, chemicals, resource efficiency and innovation. The World Summit on Sustainable Development (WSSD) held in Johannesburg in 2002 put, for the first time, sustainable consumption and production on the global agenda.

INITIATIVES

The first major expansion of the NCPC programme took place during 1998-99 with a regional approach for four Central American countries and country specific initiatives in Vietnam, Russian Federation and elsewhere. From 2000 onward new NCPCs were also set up on the African continent, including amongst others Ethiopia, Kenya, Morocco, Mozambique and South Africa (launched at the Johannes Summit in 2002) and in the Arab region. In parallel, the African Roundtable on Sustainable Consumption and Production started from 2000. Experiences and lessons learned by the first batch of NCPCs were transferred to new NCPCs through study tours and engagement of lead experts from established NCPCs as trainers and consultants in new countries. For example, the Indian NCPC provided extensive technical and related support in the Asia Pacific region, and the Czech and Slovak Centres supported the expansion in Eastern Europe, both within the framework of the NCPC programme, as well as through other programmes of UNIDO, UNEP and others, such as Asian Productivity Organization, European Union and the Organization for Economic Cooperation and Development. The increasing international awareness of and commitment to cleaner production and sustainable consumption, raised government interests and several NCPCs, including China, Czech Republic, El Salvador, Guatemala and Nicaragua, started to support government with formulation of cleaner production strategies, typically as environmental policy

strategies. In Central and Eastern Europe, the rapid approximation and enlargement of the European Union provided strong incentives for cleaner production.

New service areas for NCPCs were developed and introduced related to the transfer of environmentally sound technologies and investments therein. These were only possible with greater participation of international experts in country level activities, resulting in larger country level interventions, relative to the lean start-up of NCPCs during the earlier period. Both UNIDO and UNEP worked with selected NCPCs in thematic initiatives in areas including financing of cleaner production, integration of cleaner production and environmental management systems and transfer of environmentally sound technologies. These and parallel initiatives of other development partners resulted in further professionalization of the service delivery by NCPCs across all programme countries. Moreover, in particular in the largest emerging economies, cleaner production activities were concentrated in regional centres, indeed paving the way for decentralization into sub-national cleaner production centres, either as stand-alone centres (for example in States of Gujarat and Karnataka in India and the Chinese provinces of Liaoning, Shanghai and elsewhere) or as branches of the NCPC (for example in South Africa, Brazil and Mexico).

INSIGHTS

The use of lead experts from the first batch of NCPCs as trainers and consultants for new NCPCs and related initiatives was effective for customizing cleaner production methods and techniques to regional circumstances. For example, the contribution of staff of the Indian NCPC to the initial training and demonstrations in Vietnam was pivotal for the early achievements of this new NCPC. Other forms of South-South cooperation and learning were achieved where NCPCs were set up in parallel in several smaller countries in one region, in particular in Central America (among Costa Rica, El Salvador, Guatemala, Honduras and Nicaragua) and in a less formalized manner in Central Europe and later in Eastern Africa.

NCPCs proceeded to execute cleaner production assessments with a quick win orientation to favor low and no-cost options for immediate implementation. Different service models were further developed and trialed to create both demand and supply of cleaner production services, through circles or clubs, clinics and/or helpdesks. In parallel, initial findings and learnings from NCPCs seeded other large scale donor initiatives. From 1998, for example, the then German Technical Cooperation Agency (GtZ), started its PRofitable Environmental Management (PREMA) initiative that went on to develop a global resource pool for supporting the uptake of operational and financial management methodologies in areas like good housekeeping, environmental cost accounting and chemicals management.

It was increasingly noticed that cleaner production implementation in enterprises was stalling after implementation of the low and no-costs options which in turn were generally insufficient to achieve compliance with local standards and/or approximation to international best practices. UNIDO sought to overcome this implementation challenge with an extended methodology aimed at management integration of cleaner production in enterprises by combining cleaner production assessment with environmental management accounting and environmental management systems, as a foundation for the Transfer of Environmentally Sound Technologies (TEST methodology).

In the area of financing, UNEP found that difficulties experienced by firms in accessing financing for investing in recommended cleaner production opportunities were in the main related to the under-appreciation by the financial sector of the cost saving potential of cleaner production, as well as the short planning for and small scale of such investments, making cleaner production less attractive for financial institutions despite good returns on investments for manufacturing firms. Inclusion of financing considerations in the execution of cleaner production assessments would improve fund raising prospects for cleaner production investments for which first training and related resources were developed, inspired by amongst others the success of revolving cleaner production facility of the Nordic Environment Finance Corporation (NEFCO) initially in Lithuania and North West Russia, and later elsewhere.

A first generation of cleaner production policy inputs was provided, in for example China, Czech Republic, El Salvador, Guatemala and Nicaragua. Initially, such policy recommendations were aimed at strengthening broader strategies, for

industrial pollution control and/or sustainable development within the country. The recommendations focused in the main on expanding and sustaining the delivery of cleaner production services. Such activity-based strategies, indeed were fundamentally action plans. Recognizing the need for more strategic policy interventions, UNIDO facilitated the development of the first comprehensive cleaner production policy resource package for NCPCs, which recognized the need for integration of environment, industry, technology and related policies.

ILLUSTRATIONS

// In a first regional programme UNIDO supported between 1998 and 2002 the parallel establishment of NCPCs in Costa Rica, El Salvador and Guatemala, loosely coordinated with the set-up of NCPC in Nicaragua (from 1997) and a parallel cleaner production initiative in Honduras implemented by the Canadian International Development Agency (CIDA). By 2002, cleaner production assessments had been completed in 41, 48 and 70 enterprises, mostly from the food and related agro-industries, respectively in Costa Rica, El Salvador and Guatemala, with additionally 12 environmental management system assessments in both Costa Rica and El Salvador. Synergies between the countries were achieved in regard to exchange of sector specific cleaner production opportunities, coordination and standardization of training and outreach activities and participation with a common voice in policy consultations at country and regional level.

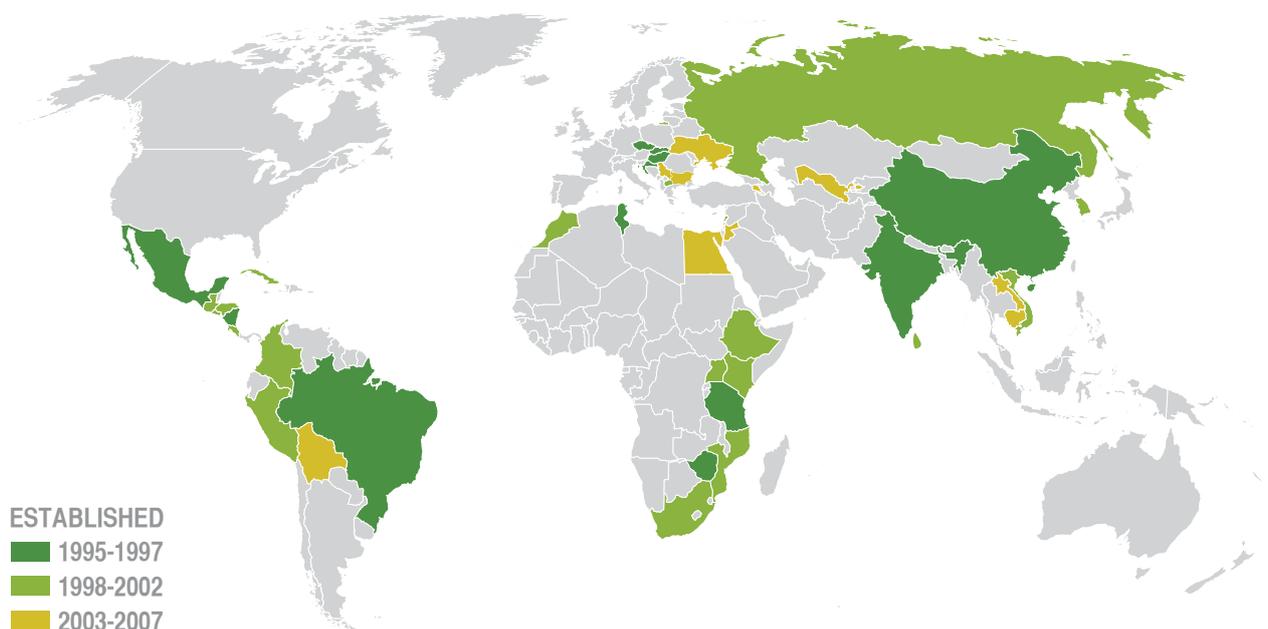
// In Vietnam, the NCPC put right from its establishment strong emphasis on technical and management training of national experts, including associated experts of counterpart institutions (universities, technical institutes, etc. from different regions) and enterprise staff. By 2002, a modular cleaner production training programme had been established comprising of four training modules totaling 15 training days (both class room and company practice). By the end of 2002, the NCPC had started 42 in plant assessments, with the 12 completed in that year identifying nearly USD 1 million of annual savings. In 2002 the first national cleaner production roundtable was organized, which attracted some 150 participants representing government, industry and academics and an action plan for cleaner production to 2005 was drawn up as a result. As a first among NCPCs, Vietnam NCPC established environmental and quality management systems, which were certified on respectively ISO 14001 and ISO 9001 in 2002.

// With support from Norway, UNEP assessed financing challenges for cleaner production in Guatemala, Nicaragua, Tanzania, Vietnam and Zimbabwe and provided training and further capacity building for both NCPCs and their associated experts as well as the financial sector. Over the duration of the project, NCPCs and their partners in these countries, developed and promoted in excess of 50 cleaner production investments, with investment volumes ranging between USD 5,000 and USD 4 million per investment project, a quarter of which secured loans during the project timeframe.

// Working with NCPCs in Croatia, Hungary and Slovakia, UNIDO developed a methodology to combine cleaner production assessments, with environmental management systems, environmental management accounting and environmentally sound technology assessment, with a view to foster the Transfer of Environmentally Sound Technology (TEST) and thereby improve environmental performance of enterprises up to international standards. The methodology was first applied in 17 high polluting industries in five riparian countries of the Danube (Bulgaria, Croatia, Hungary, Romania and Slovakia). At project end all industries had completed cleaner production and environmentally sound technology assessments and 11 of them environmental management system and 6 of them environmental management accounting. The companies had collectively implemented 121 no-cost and 109 low-cost measures. The total investment of these measures was USD 1.7 million with annual savings of USD 1.3 million and 4.6 million m³ annual

reduction of wastewater discharges in Danube. A further USD 47.3 million was needed for the 141 high costs options, of which 38 had been in principle agreed for implementation at project completion.

// In India Waste Minimization Circles (WMC) propagated cleaner production ideas through quality circles. Typically a WMC involves 4 to 6 companies from the same geographical area. At the start a two-day training in cleaner production concepts is provided, which covers: environmental and economic policy backgrounds; cleaner production concepts, benefits and methodology; WMC operation and training guidelines; action planning and reference information. Thereafter participants meet about twice monthly for approximately 1 year under the guidance of the facilitator, while participants apply cleaner production in their businesses and report and exchange experiences. After one year the formal WMC ends, but participants may elect to continue to meet regularly, or establish spin-off WMCs on their own. Between 1995-19, 18 WMCs were funded by Ministry of Environment and Forestry. During 1998-2003, a further 118 WMCs were funded by World Bank, involving over 500 small businesses from 37 industry sectors across 17 States of India, which implemented 220 options with a total investment exceeding USD 2.5 million and overall payback within 14 months.



New NCPC countries: Armenia, Bulgaria, Bolivia, Cambodia, Egypt, Jordan, Lao PDR, Serbia, Ukraine & Uzbekistan.

CONTEXT

The 2002 Johannesburg Plan of Implementation brought consumption to the fore. This resulted in a range of global, regional and national initiatives to explore opportunities and challenges for sustainable consumption and production that were loosely coordinated under the so-called Marrakech Process. The International Conference on Chemicals Management (ICCM), held in Dubai, United Arab Emirates, in 2006 agreed on the Strategic Approach to International Chemicals Management (SAICM), highlighting the importance of sound management of chemicals for sustainable development. The International Resources Panel (IRP) was formally established in November 2007 to provide a science basis for sustainable management and utilization of natural resources, reflecting growing international concern about the rapid increases in global resource consumption.

INITIATIVES

The NCPC programme further extended its geographical reach to 10 countries over this period, through a more diversified approach. Firstly, through replication of the original approach creating new NCPCs in new countries in particular in Eastern Europe (including Serbia and Ukraine). Secondly, National Cleaner Production Programmes (NCPP) were introduced as precursor for the establishment of full-fledged NCPCs in countries with smaller industrial bases. NCPPs were successfully trialed in for example Lao PDR and Cambodia from 2004, with inputs from well-established NCPC in neighboring Vietnam, as well as in Armenia and Uzbekistan. Thirdly, through incorporation and conversion of previously existing centres of expertise in cleaner production and/or related fields that had been established outside the NCPC programme, most notably through the first regional networking programme of NCPCs in Latin America, CPLatinnet, from 2003.

This expansion and diversification of the NCPCs was accompanied by a further push for market-oriented service delivery, as a means to sustain organizational independence and financial security of the NCPCs over time. NCPCs worked towards becoming separate legal entities to be able to deliver services to local business community, international development partners, national and subnational governments and the educational and professional sectors. This also led to more emphasis for business planning and management of NCPCs as independent organizations. NCPCs

furthermore worked towards creation of markets for their own services, by supporting development and implementation of national policies and strategies, in countries as diverse as Sri Lanka, South Africa and Vietnam. A further effort was made to standardize the cleaner production service model with the development and publication of the UNIDO Cleaner Production Toolkit, firstly in 2004.

Several NCPCs started to deliver technical services in support of selected green financing schemes, including e.g. Egypt, whereas others enabled the creation of attractive, incentive-based dedicated cleaner production financing instruments, referred to as green credit mechanisms (initially in Colombia and Peru, and later also in Vietnam capitalized by Government of Switzerland).

New opportunities also presented themselves to existing NCPCs with the roll out of the Marrakech process on sustainable consumption and production. Most NCPCs contributed actively in areas as diverse as industrial and building energy efficiency, sustainable tourism, sustainable public procurement and sustainable product design and eco-labeling, through capacity building, pilot projects and knowledge capture and dissemination. The European and Asia Pacific roundtables enlarged their scope from cleaner production to sustainable consumption and production. The African Roundtable on Sustainable Consumption and Production (ARSCP) was fully institutionalized in Casablanca in May 2004. Under its auspices the African NCPCs co-developed the African 10 Year Framework Programme on Sustainable Consumption and Production, which was endorsed by the African Ministerial Conference on Environment (AMCEN) in 2005.

Through UNEP, the programme supported selected NCPCs and alike institutions to demonstrate the contribution of cleaner production to industrial energy efficiency, through a regional programme with nine countries in the Asia Pacific region, yet also elsewhere, for example in Central Europe. In part as extension of the focus on energy and climate, UNEP also facilitated further work on linking cleaner production with other Multilateral Environmental Agreements, most notably the Stockholm and Basel conventions, with pilots in India and Ukraine. In parallel, through UNIDO, the programme trialed different approaches for facilitating the transfer of environmentally sound technologies, particularly through further development and roll out of the TEST methodology in Eastern Europe as well as bilateral initiatives. UNIDO also started trials to merge social responsibility and cleaner production, with initial pilots in India, Pakistan, Sri Lanka and Thailand, in first instance to sustain cleaner production through social and organizational improvements. This later founded the Responsible Entrepreneurship Achievement Programme (REAP), amongst others trialed in Croatia. Moreover Corporate Social Responsibility was integrated into service delivery in tourism sector (for example in Romania and Bulgaria) and pilot projects with the International Labor Organization (ILO) under its Factory Improvement Programme (FIP) (in Vietnam and India). UNIDO also launched thematic activities to promote chemical leasing, a service-based business model for responsible chemicals management.

UNIDO, UNEP and representatives of NCPCs continued to discuss ways forward for the NCPC programme in particular at the occasions of successive global meetings of the NCPC directors (in 2003 in Mayrhofen, in 2005 in Interlaken and in 2007 in Simmering). Consensus emerged to join efforts to update the NCPC programme in light of the emerging global and regional challenges and the maturation of NCPCs to recognized knowledge and development partners of the UN agencies. A comprehensive independent evaluation was launched in 2007 for the global NCPC programme to inform and direct the reorientation of the NCPC programme strategy.

INSIGHTS

The transition towards market-based service delivery to break the aid-dependency for long term operation of the NCPCs worked out rather differently across countries, depending to a large extent on industrial development status achieved. 'Market-based' was initially narrowly interpreted as fee payment by beneficiary, through fee-for-service payment by the enterprises receiving cleaner production advisory services. Some NCPCs converted in full to fee for service model, yet those appeared to lose the specific focus on critical elements of the NCPC concept (particularly from the perspective of the NCPC donors and UN agencies): (i) orientation to small and medium enterprises; (ii) engagement in policy and

advocacy on cleaner production; and (iii) specific focus on cleaner production. Indeed straight market-based service delivery appeared to convert a NCPC into more general environmental service provider, providing compliance related services and/or applied environmental technology research. A wider and more realistic interpretation for market-based service delivery by NCPCs emerged, as it was realized that NCPCs could indeed seek project based income from three main sources: business sector; national government; and international development partners (including UN system, bilateral programmes and multilateral environmental funds).

The market orientation required legal structures and resulted in a drifting away of NCPCs from the host institutions under which they had initially been set up. Different institutional and legal arrangements were chosen by the NCPCs, depending in part on the legal forms allowed in their home country, including: governmental trusts (for example of NCPCs in Kenya, Tanzania and Uganda); professional non-governmental organizations (for example in Costa Rica, El Salvador, Guatemala and Nicaragua); or business units of a technical university, a parastatal research organization or an employers federation (illustrated respectively in Vietnam, South Africa and Morocco). Whilst NCPCs do succeed to institutionalize at the national level, many face tough challenges and, in some cases, even opposition during their organizational and institutional transformation, causing either long delays (for example in Sri Lanka and Mozambique) and/or weakening of the original NCPC relative to emerging other cleaner production service providers (for example observed in Ethiopia, Hungary and India).

The global reach and workforce of the NCPCs continued to expand, both in terms of number of countries covered as well as service delivery capacity per country (with the larger centres employing up to dozen or more technical staff). The role of UNIDO and UNEP started to change from '(project) manager of the NCPC' to 'client of NCPC' as the relative share of UNIDO and/or UNEP in activities of the NCPCs gradually declined, in particular in the middle-income countries. The historic form of exchange and learning among NCPCs, largely centralized through UNIDO and/or UNEP, became overstretched with increased number of countries and larger and more diverse activities in many countries. At the same time the experiences in Latin America showed the potential of closer cooperation between NCPCs at the regional level.

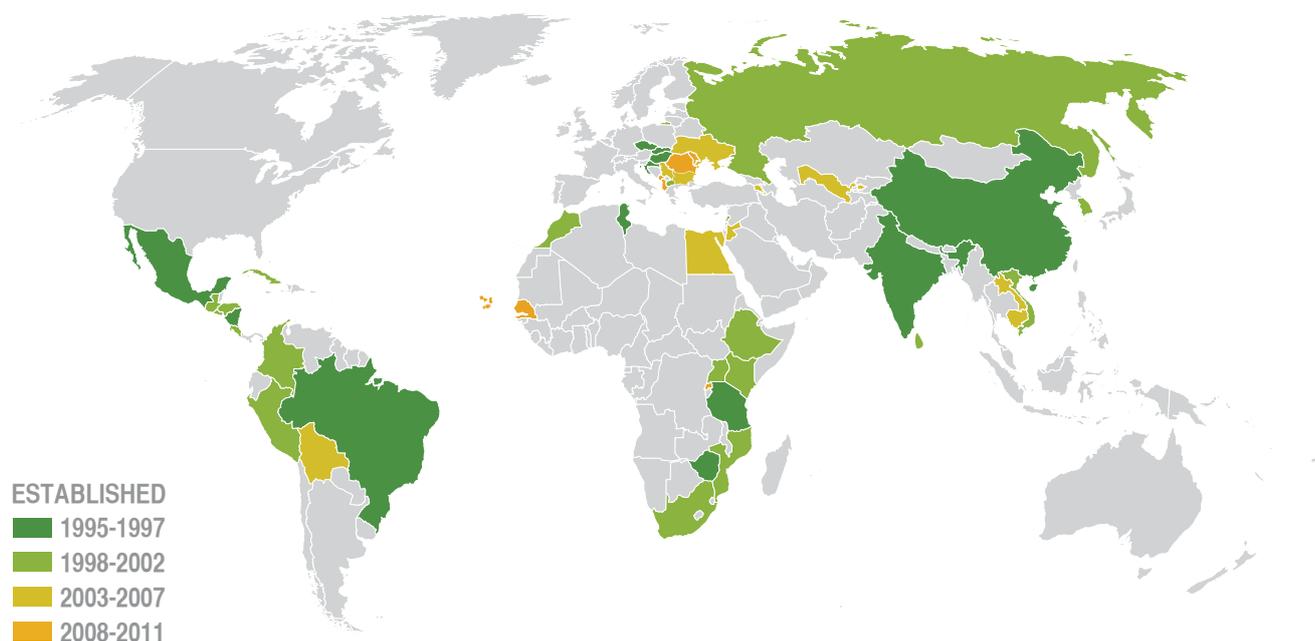
A project aimed to facilitate investments in bilateral clean technology transfers from Switzerland to China and India, failed during 2003-2007 in its initial design due to high cost and low adaptability of Western technology. After reorientation on target sector technology needs and inclusion of knowledge and auxiliary technology, though it set the stage for clean technology innovations in chemical and textile sectors in respectively India and China, from 2008 onward.

ILLUSTRATIONS

// The Green Credit Line, first launched in 2003 in Colombia and later replicated in Peru and Vietnam assists enterprises to finance profitable investments in cleaner production. The scheme operates through commercial banks, using their own capital. For pre-approved cleaner technology projects, the Green Credit Line, capitalized by the Swiss Government, can provide guarantees to overcome shortage in collateral for accessing a loan. Upon independent evaluation of the environmental benefits achieved after completion of the investment, under the auspices of the NCPC, the company can receive a reimbursement of up to 15% or 25% of its loan, provided it achieves predetermined level of resource savings and/or waste reduction. Between 2003 and 2015, loans worth USD 12.4 million were made through the Green Credit Line in Colombia, and a total of USD 3.4 million reimbursed. An early beneficiary was Aceros Industrialis, a steel wire company, which invested USD 640,000 to replace chemical with mechanical surface treatment, thereby eliminating wastewater, avoiding about 400 ton greenhouse gases and achieve annual benefit up to USD 500,000, including from reduced down time. The company received a USD 200,000 reimbursement on its loan through the Green Credit Line.

// In China, the NCPC had facilitated regulatory reform leading to the adoption of the China Cleaner Production Promotion Law, which came into effect in 2003. The Law provides the environmental authorities a mandate to instruct highly polluting enterprises to conduct Cleaner Production Audit and implement resulting opportunities. Moreover it established a system of Cleaner Production sector guidelines. The NCPC supported the further operationalization of the legislation in following years. By the end of 2006, environmental authorities had mandated Cleaner Production audits in 2,710 enterprises. This included 618 audited companies in the Province of Liaoning, which had reportedly implemented 9,736 cleaner production options at a total investment of approximately USD 725 million. The cumulative annual environmental benefits were estimated to include coal savings of 1.6 million ton, water savings of 194 million m³, electricity savings of 308 million kWh and reductions of waste and wastewater by respectively 2 million ton and 303 million m³.

// UNEP implemented between 2003 and 2006 the GERIAP Project (Greenhouse Gas (GHG) Emission Reduction from Industry in Asia and the Pacific (GERIAP)), which demonstrated energy savings and associated reductions of GHG emissions through the application of cleaner production and resource efficiency methods and techniques. The project covered five sectors (cement, chemicals, ceramics, iron and steel and pulp and paper) in nine countries: Bangladesh, China, India, Indonesia, Mongolia, Philippines, Sri Lanka, Thailand and Vietnam. Working with NCPCs of India (lead technical partner) and of Vietnam and other technical counterparts in respective countries, integrated energy efficiency and cleaner production assessments were completed for over 40 companies. For example, in Indonesia, two cement and two iron and steel plants, implemented together 15 options, with pay back periods in range of 2 to 30 months. The total investment mounted up to USD 385,000 and generated annual benefits of USD 2.2 million, reduced power consumption by 7.7 million kWh, coal consumption by 37.4 kton, natural gas consumption by 2,900 gJ and diesel consumption by 1 kton; mitigating a total of 94.7 kton CO_{2-eq}. In the fifth Indonesian demonstration company from pulp and paper sector energy and cleaner production options were integrated in a major redevelopment of the plant and hence could not reasonably be costed separately.



New NCPC Countries: Albania, Cape Verde, Montenegro, Republic of Moldova, Romania, Rwanda and Senegal.

CONTEXT

Development partners scaled-up their investments for sustainable consumption and production in developing and emerging economies, including most notably the European Union through SWITCH-Asia, and others, like Sweden for example for the Lake Victoria riparian countries and Finland for the Mekong riparian countries. The concept of green economy gained traction. Using the NCPC network as a platform UNIDO launched green industry as the sector strategy for the contribution of the manufacturing and related productive sectors to the green economy, during the Manila Green Industry Conference in 2009, jointly with UNEP, ILO and the Economic Commission for Asia and Pacific (ESCAP). Progress was reviewed during successive green industry conferences in Tokyo and Guangzhou (2011 and 2013). The Commission for Sustainable Development (CSD) developed in 2011 the 10 Year Framework of Programmes (10YFP) on Sustainable Consumption and Production, which was reaffirmed by Heads of State at the United Nations Conference on Sustainable Development (Rio+20) in 2012. Further milestones in putting resource efficiency on the international agenda included the launch of the first decoupling report by the International Resources Panel and the release by the European Union of its roadmap to resource efficient Europe, both in 2011.

DECOUPLING: PATHWAY TO CIRCULAR ECONOMY

The world has achieved historic levels of affluence. Poverty though persists in many areas and the rising incomes have exacerbated extraction of natural resources and environmental degradation. Global resource use increased eightfold during the 20th century, and it is estimated that between 2010 and 2030 the demand for key resources will further increase by 30-50%. Global resource consumption exceeds sustainable supply by 50% - already 1.5 planets Earth are required and this is expected to worsen to about 2.5-3 planet Earths by 2050. The past and present models of (industrial) production and consumption are no longer viable for the future. Further economic growth, required to meet at least the basic needs of the global poor, must be decoupled from increased resource use and environmental impacts.

In the decoupled scenario, the economy would grow at a much faster rate than consumption of materials, water and energy and generation of waste, emissions and effluents, with the ultimate aim to even decrease resource consumption and pollution generation in absolute terms, whereas in addition economy would adapt to changes in climate. This requires radical shifts in production and consumption systems, though application of resource efficient and cleaner production methods, technologies and policies, and ultimately the perpetual use and reuse of non-renewable materials, a concept coined as circular economy, initially in China. The resulting reduced stress on natural resources, climate and ecosystems, and human health, presents new business opportunities to produce resource efficient services, products and technologies, including those using renewable resources, along with cost savings from more productive processes in all sectors. Decoupling though is not just a technical affair as, indeed, it requires visionary policy and behavioral changes of producers and consumers to spur all forms of innovation, in technologies, products and services, business models and indeed consumption patterns and lifestyles.

INITIATIVES

Based on the findings and recommendations from the 2007 global NCPC evaluation, UNIDO and UNEP redeveloped a programmatic approach for supporting NCPCs. The term cleaner production was expanded to Resource Efficient and Cleaner Production (RECP) to highlight the strategic importance of preventive environmental management and total productivity techniques to deal simultaneously with multiple global, regional and local environment, natural resource and climate concerns. The experiences of the Latin American network were taken forward to create a global network with merit-based tiered membership, to include RECP service providers that had not been set up as a traditional NCPC under the joint UNIDO UNEP NCPC programme. The programme strategy further provided a template for RECP interventions at national, thematic and global levels aimed at moving NCPCs and their partners from demonstrating RECP to scaling-up and mainstreaming RECP, through: strengthening of RECP service delivery capacity; demonstrating of thematic applications of RECP (for resource efficiency, pollution prevention and sound chemicals management); mainstreaming of RECP in policy and enterprise financing; and supporting innovation in cleaner technologies and sustainable products. The programme was inaugurated during the first RECP networking conference, held in Luzern, Switzerland, in October 2009, at which occasion participating NCPCs and partners agreed to establish the global RECP network (RECPnet) to bundle resources and present a unified case for greater consideration of and investment in RECP initiatives globally. The proposed charter and operational modalities were endorsed, paving the way for the formal establishment of RECPnet in 2010. The first member assembly of the 41 founding members of RECPnet was held in Nairobi in October 2011, back-to-back with the 2nd RECP networking conference, at which occasion members adopted their Nairobi declaration. In a further response to the findings of the global programme evaluation, using inputs from NCPCs, first primers were developed on: good practices for management, organization and governance of RECP service providers; and for standardized enterprise level resource productivity and pollution intensity indicators. Moreover, further manuals were developed on respectively resource efficiency in small and medium sized enterprises and responsible production, initially trialed by NCPCs in Ethiopia and Vietnam and later elsewhere.

In parallel, new NCPPs were initiated in this period in Albania, Cape Verde and Rwanda, all funded from one UN funds in the respective countries, as well as with traditional bilateral funding in e.g. Moldova, whilst in parallel the programme expanded its geographic reach as new non-NCPCs joined *RECPnet*, for example from Indonesia and Philippines. UNIDO continued to support technology transfer initiatives for solar thermal systems to produce hot water in Nicaragua, integrated solid waste management in Cuba and new chemical process technologies in India. Supported by the environment-responsible ministries of Austria and Germany, UNIDO also elaborated an enterprise-level methodology for chemical leasing, which was piloted in cooperation with seven NCPCs, including Columbia, Egypt, Mexico and Russia. UNEP proceeded with demonstration activities on sustainable product innovation, including in Vietnam, Lao PDR and Cambodia, and UNIDO expanded activities on Corporate Social Responsibility also in Vietnam, in both cases funded through the SWITCH Asia Programme of the EU, to which also other NCPCs in the Asia Pacific region contributed.

INSIGHTS

The global programmatic evaluation, concluded in early 2008, confirmed that the NCPC programme had resulted in substantial benefits at country and global levels, yet that the potential of the programme was not yet fully utilized, particularly given the deepening of the global, regional and local environment, natural resource and climate concerns. Outcome-orientation was noted as unfortunately weak due to the lack of systematic follow up to assessment findings and indeed monitoring of actual benefits achieved by NCPC-assisted enterprises, augmented by the lack of common indicators to monitor the impacts of NCPC services in a transparent and verifiable manner. Moreover, a critical challenge for NCPCs is the necessary transition from an international technical cooperation project (their original status) to a nationally-owned and nationally-directed service provider able to catalyze widespread adaptation and adoption of cleaner production in their home country. This also requires a balance between public good activities (advocacy and policy support, training, information dissemination and knowledge generation and sharing) and enterprise assessments (aimed at private benefit for the assessed enterprises), each requiring their own funding modalities.

The cooperation and knowledge sharing among NCPCs, and later on other members of *RECPnet*, evolved significantly during this period. NCPCs – and indeed all programme stakeholders – gradually learned more about the activities and competencies of each other: firstly from the detailed documentation of 19 NCPCs during the 2007 programme evaluation; secondly from regional status reports prepared for and subsequently discussed at the first RECP networking conference in 2009; and thirdly from regional mapping and expert group meetings on regionally prioritized themes during 2010. The previous centralized networking and knowledge sharing model (in the main through the UN programme managers) started to decentralize to knowledge sharing at regional level.

Albania, Cape Verde and Rwanda were able to launch NCPPs in the framework of their country's One UN Plans with One Plan Funding, which enabled greater cooperation and joint delivery of UNIDO and UNEP expertise to the start-up of RECP activities in these countries. The declining availability of One Plan funding along with increased competition for this funding and its annual budgeting though lacked the medium term predictability for these NCPPs to flourish, except where additional substantive funding could be mobilized as in the case of Rwanda. In several other countries, RECP activities succeeded to obtain funding from multi-donor trust funds, such as the Millennium Development Goals Achievement Fund (including in Turkey and Vietnam) and post crisis funds (including Iraq), whilst a growing number of NCPCs started to serve as project executing units for projects funded by the Global Environment Facility (GEF).

As green industry, and indeed green economy as a whole, gained wider acceptance, and reflecting on its role in the actual realization of these transitions, the NCPC community started to explore the concepts of mainstreaming and scaling-up. It was found that scaling-up would need to go beyond multiplication of current activities and services of NCPCs, and indeed require new and diversified service delivery and partnership approaches at country level. It was further realized that mainstreaming calls for strengthening and integration of environmental, industry and possibly other policies affecting small-scale industries, including strengthening of implementation and - where necessary - enforcement.

ILLUSTRATIONS

// Chemical Leasing entails a service-oriented business model for chemicals suppliers that shifts the focus from increasing its volume of chemicals sold towards value-addition through those chemicals to the chemicals user. The supplier is paid on the basis of functional or productive units delivered by the chemicals it has supplied, regardless of the volume of chemicals used therefore. In the case of conveyor belt lubrication, for example, the payment basis could change to effective running time, rather than lubrication chemicals used, which was done by Knjaz Milos, producer of bottled water in Serbia, economize annual chemicals use by EUR 5,700 (40% cost saving), whilst also reducing annual water use by 1,500 m³ and annual chemicals consumption reduced by 1.8 ton (30%). Launched in 2004, UNIDO's chemical leasing programme supported in its first 10 years 55 pilot applications in cooperation with NCPCs in 11 countries, including Egypt, Russia, Serbia and Sri Lanka. A chemical leasing award was established with support from the Austrian and German governments. Awards were presented in 2010, 2012 and 2014 in categories covering case studies, service providers, promotion activities and scientific research. In 2014, gold awards were provided for case studies on cleaning in hospitality sector in Brazil and for anti-corrosion in automotive sector in Colombia, and in the category of service providers to the NCPCs in Nicaragua and Serbia.

// In November 2008, NCPC South Africa celebrated six years of achievement and conclusion of the period of direct donor support through the NCPC programme from the Governments of Austria and Switzerland. During this period, the NCPC implemented cleaner production assessments in 52 industries from three target sectors: chemical (26 plants); agro-food (21 plants); and textiles (5 plants). The NCPC supported the drafting and start of implementation of the first cleaner production strategy, coordinated by the Department of Environment and Tourism. This strategy included 23 objectives in five clusters: information and awareness; capacity building; technology development and cooperation; financial support; and policy and regulation. It also assigned responsibility for implementation among government departments and support institutions, including the NCPC. The NCPC had transitioned to an independent unit of the Council for Scientific and Industrial Research (CSIR), governed by an executive committee with participation of government and business sector. Meanwhile NCPC South Africa also secured a stable funding basis under the competitiveness programme of the Department of Trade and Industry. The organizational development of NCPC South Africa was profiled in 2009, along with those of the NCPCs in China, Guatemala, Slovakia, Tanzania and Vietnam, as input for the UNIDO-UNEP primer on good organization, management and governance practices for RECP Service Providers.

// The second phase of the environmental technology transfer project in India, focused on cleaner technology options for the Ankleshwar Industrial Estate in Gujarat, home to some 500 small-scale industries, mainly from chemical sector. Cleaner production training and cleaner technology assessments were delivered to over 50 key chemical enterprises, in close cooperation with the Gujarat Cleaner Production Centre. Technology transfer and adaptation focused in the main on introduction of: (i) continuous process for dyestuff manufacturing; (ii) catalytic oxidation with oxygen to replace benzoic acid oxidation of toluene in dye-intermediate manufacturing; (iii) sulphuric acid recovery; and (iv) plasma-treatment of hazardous organic wastes. Applied in full, these technologies can annually avoid up to 110,000 ton GHG emission and 85,000 ton of hazardous waste. The positive experiences of applying cleaner production in a coordinated and synergistic manner in an industrial estate created renewed interest to integrate cleaner production at the level of industrial estates and thereby contribute to the transition into (eco)-industrial parks.

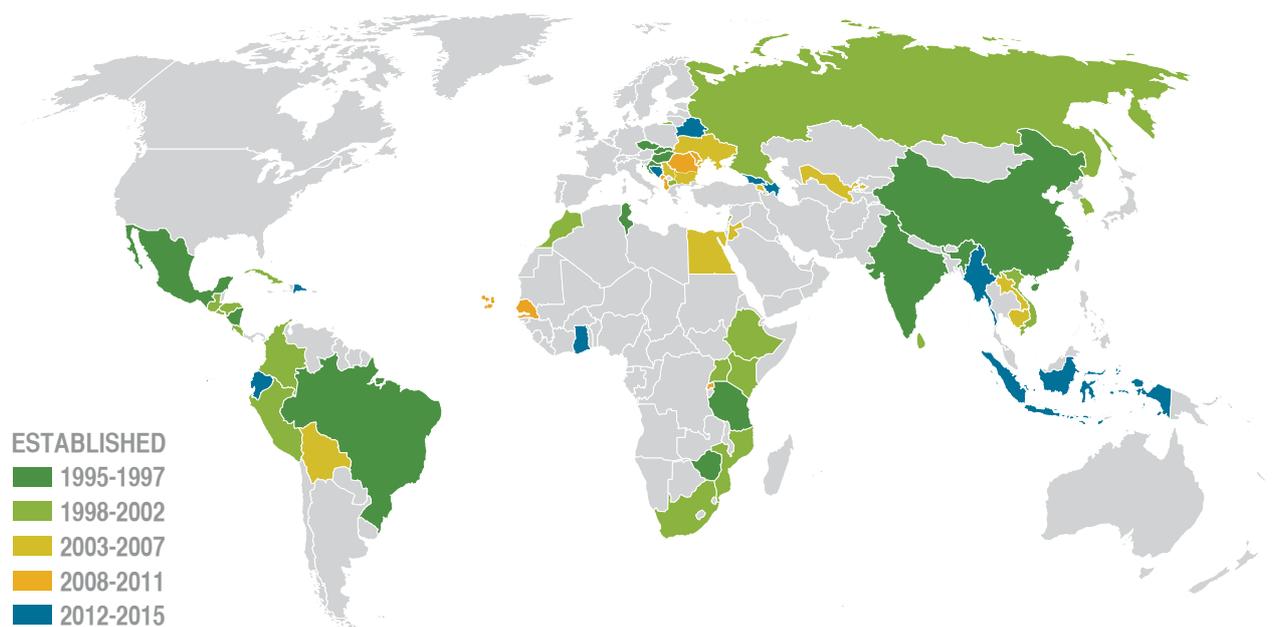
// Up to about a quarter of the NCPCs became involved in one way or another in the implementation of sustainable tourism pilot activities in particular in regard to improving operations of hotels and their

suppliers. As such these contributed directly and indirectly to the Marrakech Task Force on Sustainable Tourism (that later transformed into the Global Partnership for Sustainable Tourism). For example, in Sri Lanka, the NCPC assisted Heritage Kandalama Hotel, which was able to decrease total energy and water use by respectively 3 and 8% whilst during the same period increasing occupancy by 52%. Its experience was used to validate a set of standard enterprise level resource efficiency and pollution intensity indicators, for which a primer was published by UNIDO and UNEP in 2010 with enterprise level illustrations from Kenya, Peru and Sri Lanka. The Lao centre demonstrated savings in range of 15 to 60% on energy and water use and wastewater generation in a cross section of different hotel categories. In Bulgaria and Romania, the sustainable tourism projects combined cleaner production and corporate social responsibility at level of hotels and encouraged application of destination management schemes. In the case of Romania, 17 hotels were supported and a total of 470 cleaner production and 230 social responsibility options were developed and promoted. In Nicaragua, the NCPC coordinated the demonstration and installation of solar thermal systems for hot water totaling 300 m² collector surface in 9 hotels and 8 food companies, with a total investment of USD 270,000 and expected GHG benefits equaling almost 90 ton CO_{2-eq}/year, and facilitated the transfer of relevant technical knowledge and creation of national capacity for design, installation and maintenance of such systems.

// At the initial initiative of the NCPC in Kenya, a regional RECP component covering Burundi, Kenya, Rwanda, Tanzania and Uganda was included in the second phase of the Lake Victoria Environmental Management Programme, being implemented between 2009-2015 with funding from the Government of Sweden and GEF, and matched by World Bank loan. In first instance, NCPCs mapped industrial pollution sources in Kenya, Tanzania and Uganda and narrowed down to 88 polluting enterprises, responsible for approximately 7,000 ton of pollutant discharges annually into the basin. Following awareness raising and enterprise training, detailed RECP assessments were undertaken in all industries. The Kitumbe Tea Factory in Kenya, implemented for example rain water harvesting, solar drying, LED lighting and modified withering troughs, along with a rope way for tea transport to reduce the felling of trees, achieving amongst others a 60% reduction in specific water use and a 20% reduction in specific energy consumption. The first 30 enterprises in Kenya, Tanzania and Uganda invested some USD 81 million to achieve annual savings worth USD 14.5 million. These summary figures, though, are distorted by high end-of-pipe investments in waste water treatment at just three companies (joint investment of nearly USD 65 million with annual savings of only USD 2.3 million), meaning that on average the other 27 companies made investments with a pay back of less than 15 months. The initiative has now been expanded to Burundi and Rwanda.



Seminar Resource Efficient and Cleaner Production [RECP] in ASEAN Member States



New NCPC Countries: Azerbaijan, Belarus, Bosnia Herzegovina, Dominican Republic, Ecuador, Georgia, Ghana, Indonesia, Mauritius and Myanmar.

CONTEXT

The Rio+20 United Nations Conference on Sustainable Development, convened in June 2012, through its outcome document, “The Future We Want”, de facto launched the preparation of the post-2015 global development agenda. These centered on the preparation of the Sustainable Development Goals (SDGs) that were finally adopted in September 2015. Sustainable Consumption and Production is included as a cross cutting enabler as well as a separate SDG9 to ensure responsible patterns of consumption and production. Green economy and green growth continued to gain further currency, amongst others as a result of backing by leading global economic forums, including OECD, G8 and G20. Moreover, selected emerging and developing economies grounded the next version of their national socio-economic development strategies and plans on green growth principles, as evidenced by the national green growth strategies of for example Republic of Korea, Cambodia, Malaysia and Vietnam. In parallel, the technology mechanism under the Climate Convention was being operationalized, including the establishment of the Climate Technology Centre and Network (CTCN), jointly hosted by UNEP and UNIDO and officially launched in 2013.

INITIATIVES

From 2012 UNIDO and UNEP had significant programmable funding available for supporting the further development and demonstration of RECP methods and tools jointly with members of RECPnet, through contributions from respectively the Government of Switzerland and the European Commission (through the Eco-Innovation project). UNIDO and UNEP prioritized expanding the reach of RECPnet and deepening the understanding and impact of different types of RECP interventions.

For RECPnet, regional chapters were formed and chapter meetings convened in 2013, 2014 and 2015 for all five regions, typically back-to-back with global networking conferences and/or relevant regional meetings (such as regional sustainable consumption and production roundtables in Africa, Asia Pacific and Europe in 2014). Moreover, emphasis was put on formalization of knowledge management and compilation of a global evidence base of enterprise experiences adopting a common set of impact indicators. RECP and related capacities in the regions were mapped, which further contributed to the growth in membership of RECPnet from 41 founding members representing 37 developing and

transition countries at the end of 2010 to 71 members representing 56 developing and transition countries in 2015.

In terms of deepening insights and impacts of RECP service delivery, UNIDO focused in the main on advanced methods and techniques for achieving greater reductions of industrial organic wastes and minimization of chemical risks and wastes on a sector-by-sector basis, and good practices for eco-industrial parks and for leveraging investments in RECP (including through innovative business models). The mainstream RECP methodology was therefore further developed to foster low carbon industry, and trialed in rice, coffee and cassava sectors in Cambodia, China, Colombia, Peru and Vietnam. In parallel the RECP methodology was also retuned to focus on innovations for reduction of chemicals' use, wastes and risks, covering chemicals' synthesis, formulation and industrial use, and trialed in paint, textile wet processing and related sectors in Colombia, Egypt, El Salvador, Guatemala, Morocco and Peru.

At the same time, UNEP started to champion the concept of eco-innovation: based on life cycle thinking, eco-innovation fosters radical innovation at the level of business strategy, which helps rethinking the strategic connection of SMEs and their value chain, and to understand where and how to intervene to add value to all stakeholders (i.e. responsible SMEs). To this effect, new eco-innovation methodologies were developed to intervene at enterprise and policy levels and nine members of RECPnet have started to trial these in their home countries in food processing, metals processing and chemicals production and use.

The reach of the RECP programme continued to expand, partially through starting new national RECP programmes in countries like Dominican Republic, Ecuador, Indonesia and Myanmar, and partially within the framework of regional green economy partnership initiatives, such as the EUs Eastern Partnership Green Economy Initiative (covering Armenia, Azerbaijan, Belarus, Georgia, Moldova and Ukraine) as well as elsewhere. Established NCPCs continued to assist with kicking off new RECP activities in neighboring countries.

Established NCPCs also continued to diversify their service portfolios, continuing the expansion of RECP applications to hospitality and health sectors, water supply and waste water treatment, agriculture, aquaculture and fisheries, and crafts, each in selected countries. The client base also diversified as members of RECPnet were contracted by international consumer good buyers to support their local producers to achieve compliance with their environment, energy and/or social procurement standards, in particular in apparel, footwear and hotel sectors, in e.g. Bulgaria, Cambodia, Philippines, Sri Lanka, Tunisia and Turkey.

INSIGHTS

Interest of new countries in RECPnet retained strong, as evidenced by the steady growth of the membership base of RECPnet, in particular at the level of observer members – the entrance level for new service providers. The formalization of regional chapters contributed to a gradual, and still continuing, transition of the initiative for RECPnet from its secretariat (provided by UNIDO and UNEP) to its Executive Committee (elected regular members of RECPnet). The significant investments in on-line system and tools for knowledge management and cooperation only to a limited extend started to overcome inertia towards active contributions from RECPnet members to the network. On the other hand though, parallel project activities by multiple members under same thematic umbrellas did result in cross-fertilization of concepts and experiences, and - indeed - joint learning and innovation, in areas like low carbon industrial development, eco-industrial parks, eco-innovation, chemical leasing and innovative chemicals management.

RECPnet members from 12 countries for example compiled a global review of experiences with the development and implementation of eco-industrial parks in developing and emerging economies. The tapestry of experiences revealed an initial typology, in particular: clusters of enterprises with exceptional environmental practices in their own operations; clusters of enterprises with exceptional environmental performance through collective exchanges of wastes and resources; clusters of enterprises collectively manufacturing environmental products/technologies; and clusters of enterprises collectively delivering environmental and resource conservation services. Moreover, this pointed to interpreting eco-industrial park as an evolutionary development of new and/or existing industrial zones, along multiple dimensions, including enterprise level and collective actions, and industrial zone planning, construction, management and operation.

A human capacity development intervention, managed by the German Agency for International Cooperation, GIZ, supported 13 members of RECPnet to improve their capacity to plan, organize and manage their own activities and services systematically. This built upon the 2009 publication and subsequent promotion of a good practices primer on management, organization and governance of RECP service providers. As a recurring challenge, the RECP service providers are seeking a balance between, on one hand, 'serving the market' (for RECP services), by conducting RECP and alike assessments for enterprises, and, on the other hand, 'creating the market', by undertaking advocacy, training, information sharing and policy support. At times, these roles compete, and indeed source and predictability of funding were found to constrain the ability of RECP service providers to do both in a balanced manner. Better understanding of these strategic challenges enhances the assertiveness, flexibility and resilience of the RECP service provider and indeed its ability to sustain itself, organizationally and financially. It also improves vision and strategy for contributing most effectively to scaling-up and mainstreaming RECP in the home country, over and beyond maintaining the status quo of the RECP service provider itself.

In particular within the context of regional green economy initiatives supported by the EU in Africa, Mediterranean and Eastern European regions, RECP service providers and their partners started to explore different ways to make RECP relevant and significant in the national transitions to green economy, requiring RECP uptake at speed and scale, in terms of numbers of enterprises implementing RECP, scale of environmental and resource savings achieved by them and publicly funded effort to achieve such. Among the many challenges, a particular persistent one is the need to overcome indifference on the part of in particular small and medium enterprises, as they perceive that they are told to do something for the environment, rather than understanding that such is in their own business interest. This pointed to the need to instill among entrepreneurs the 'desire to act', amongst others by communicating and engaging with them in locally-appropriate terminology, adapting methods to their business circumstances and reflecting on national socio-economic, environment and natural resource priorities. Other leverage points for scaling-up, include new and scalable service models to assist groups of enterprises at local or sector level - rather than one-by-one - as well as stronger integration of RECP in management and accounting systems, through for example material flow-cost accounting and integrated management systems.

ILLUSTRATIONS

// Established in 2003, CPLatinet, brought together the Cleaner Production initiatives from 12 countries in Latin America and Caribbean. Members established a knowledge management system and started to develop and apply common approaches and collaborate in joint projects. In its first 10 years of operation, members of CPLatinet, delivered 3,346 awareness and outreach activities and provided technical support to 4,830 enterprises, enabling these to achieve annual reductions in GHG emissions of 652 kton, waste generation by 981 kton and water conservation of 61 Gl. Moreover, all member countries had put cleaner production policy or strategies in place. At its 10th anniversary, celebrated in connection with the 15th General Conference of UNIDO in Lima in December 2013, CPLatinet transformed into the Latin American and Caribbean Regional Chapter of RECPnet. This UNIDO General Conference proceeded to adopt the Lima Declaration on Inclusive and Sustainable Industrial Development, signaling the desire of member states to bring industrialization to the core of the post 2015 international development agenda, which was achieved in September 2015 with the inclusion of SDG9 (on industry, infrastructure and innovation) in the 2030 Sustainable Development Goals.

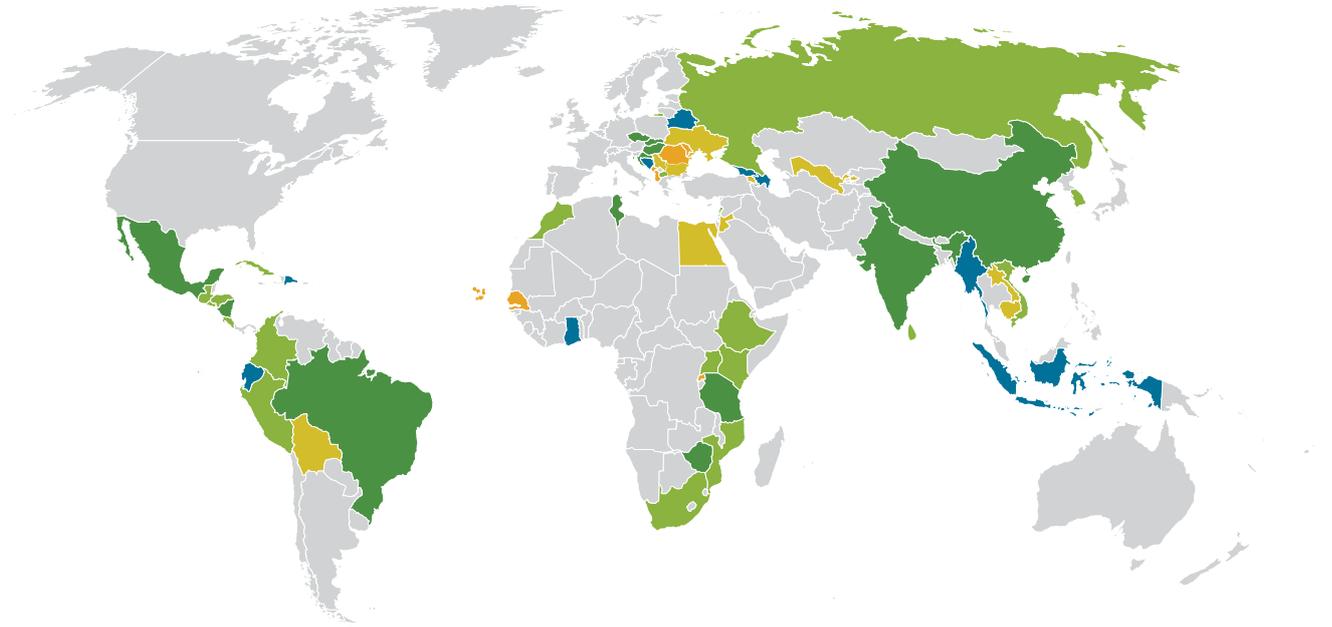
// UNIDO supports since 2013 the development and application of Innovative Approaches for the Sound Management of Chemicals and Chemical Wastes, in partnership with NCPCs in Colombia, Egypt, El Salvador, Guatemala, Morocco and Peru. Innovations are pursued in consumer chemical products,

production processes, management systems and business models that contribute to reduction of chemical use, substitution of hazardous chemicals, reduction of chemical waste and/or reduction of chemical risks. The approach has been developed and piloted in 22 enterprises, covering synthesis of chemicals, formulation of chemical products and industrial use of chemical products, and is supported with a toolbox, providing both methodology as well as background on green chemistry, hazard reduction and management and chemical leasing. For example, the project facilitated the introduction of unleaded pigments at Caralz, a small automotive paint formulator in Colombia. The project experiences in the paint formulation sector have resulted in a spin-off project to foster unleaded pigment use in paint formulation sector in Bolivia, Colombia, Ecuador and Peru, for potential GEF funding, in support of the aims and objectives of the UNEP-led Global Alliance to Eliminate Lead in Paint.

// Several NCPCs have engaged with the rice milling sector given its widespread presence among the target countries for the RECP programme. The RECP programme developed an integrated approach for minimization and utilization of organic byproducts (broken rice and husks) and energy efficiency as drivers for low carbon industrial development which was piloted by NCPCs in 18 rice mills from Cambodia, Colombia, Peru and Vietnam. Across the mills a spectrum of efficiency options was identified to improve motor efficiencies and reduce rice losses, with potential energy savings in range of 5-15% (for newer and older mills respectively) and reduction of rice losses by some 5 %. On average only some 20% of rice husk generated was usefully applied at or in the vicinity of the rice mills, leaving significant resource efficiency opportunity open to use, depending on specific mill circumstances, rice husk for on-site paddy drying, independent power generation and/or as alternative fuel and raw material for cement making. The related GEF funded industrial energy efficiency project in Cambodia supported rice millers to introduce rice husk gasification (for power generation) and rice-husk fired paddy driers. For example, Norm Sri Rice mill installed both systems, with total investment of USD 370,000 to achieve annual savings of USD 600,000, and reduce GHG emissions by 700 ton CO_{2-eq} year, 55% of the company's total emissions.

// UNIDO implemented jointly with International Trade Centre (ITC), International Labor Organization (ILO), Food and Agriculture Organization (FAO) and United Nations Conference on Trade and Development (UNCTAD), from 2010-2013 a programme to reduce poverty in handicraft villages through the development of sustainable value chains, particularly for silk, bamboo and rattan, seagrass, handmade paper and lacquerware. The Vietnam Cleaner Production Centre working with the Handicrafts Research and Development Centre and their associated experts assisted with the introduction of cleaner technologies and sustainable product designs for bamboo, silk and lacquerware sectors, including RECP assessments in 50 crafts enterprises, RECP and sustainable design training for 65 trainers, and onward grassroots RECP training for 1,430 crafts households and master craft skills training for 251 households. In addition, sustainable product designs were promoted for 20 enterprises. The joint programme was found to have improved incomes of the participating crafts producing households by an inflation-adjusted 16.5% relative to 9.2% for the control group over the 3-year project duration.

// Working with NCPCs and related technical centres in Egypt, Morocco and Tunisia, UNIDO implemented Transfer of Environmental Sound Technology (TEST) project between 2009 and 2012. A total of 43 enterprises received assistance with execution of cleaner production assessment and implementation of environmental management system and environmental management accounting. The project identified a total of 765 distinct options of which 76% had been implemented on project completion. The companies invested approximately USD 20 million (average of USD 465,000 per enterprise) to achieve annual savings mounting up to approximately USD 17 million (average USD 400,000 per enterprise). The collective annual resource savings were 9.7 million m³ water and 263 GWhr.



CONTEXT

The Sustainable Development Goals, agreed upon by world leaders in September 2015, provide an aspirational and transformative international development agenda, both for addressing key global concerns – including poverty, health and nutrition, environment, climate and natural resources -, as well as for reorienting the engines of global development – including industry and innovation, economy, consumption and production systems, education and good governance. Future socio economic progress is to be decoupled from its past and present trade-offs - pollution and waste, depletion of natural resources and accelerated climate change. This requires a circular economy: resource productivity and zeroing out of waste and pollution become the norm and are commonly practiced, now and forever, in all aspects of the economy and indeed society at large, through all means and technologies, both already existing and newly-imaginable, including, as a starting point, Resource Efficient and Cleaner Production.

TRANSFORMING OUR WORLD: THE 2030 AGENDA FOR SUSTAINABLE DEVELOPMENT

Adopted by Heads of State and Government in September 2015, Transforming our World, is a plan of action for people, planet and prosperity that also seeks to strengthen universal peace in larger freedom. The scale and ambition of the Agenda is set by the 17 Sustainable Development Goals (SDGs) and their 169 targets. These are accepted by all countries and are applicable to all, taking into account different national realities, capacities and levels of development and respecting national policies and priorities. To be attained in partnership, the SDGs provide guidance not only to governments and international community, yet also to business sector and civil society.

NCPCs individually and RECP*net* collectively can unlock and catalyze progress in particular in the areas of responsible consumption and production, inclusive and sustainable industry and decent work and economic growth.

- SDG12 - ensure sustainable consumption and production patterns - reaffirms commitment to implement the 10 Year Framework of Programmes on Sustainable Consumption and Production, and targets, amongst others, to half, by 2030, per capita global food waste, and, by 2020, to achieve the environmentally sound management of chemicals and all wastes, throughout their lifecycle, for which companies are encouraged to adopt sustainable practices and report on the outcomes thereof.
- SDG9 - build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation - is aimed to significantly raise industry's share in employment and gross domestic product, by 2030, and double its share in least developed countries, and, also by 2030, retrofit industries to make them sustainable, with increased resource-use efficiency and greater adoption of clean and environmentally sound technologies and industrial processes.
- SDG8 - promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all - targets sustained per capita economic growth – 7 per cent per annum in the least developed countries -, whilst progressively improving global resource efficiency in consumption and production and endeavor to decouple economic growth from environmental degradation.

These and other specific SDG targets aspire outcomes that NCPCs have been able to achieve within selected industries and sectors in their home countries, and NCPCs individually and RECP*net* collectively stand ready to scale-up and mainstream such, as a unique resource to their country's efforts towards achieving the SDGs.

INITIATIVES

Further initiatives to position RECP*net* and its members as enablers for the mass-development of resource efficient and climate-resilient industry are being conceptualized and developed. A critical challenge remains to demonstrate the relevance of the enterprise level achievements through RECP, typically measured in tons or kilo-tons of resource savings or emission reductions, with global decoupling and low carbon necessities and goals, that are debated at scales of mega- and giga-tons. To start eliminating such mismatches in scales, RECP*net* has started to better document actual enterprise-level impacts of RECP implementation as a basis for realistic estimates of potential benefits would RECP be widely-applied covering entire industrial sectors and value chains. The emerging and likely future changes in climate are adding further complexity, even though, for example, the climate-change-induced changes in availability of water and crops/biomass, could at least in the industry sector in principle be addressed with the known RECP concepts and methods.

Whilst further facts on both necessity for and benefits of RECP will inform and could ultimately convince policy makers and business leaders alike, new approaches are needed to then implement RECP efficiently and effectively

at scales that transform, or indeed decouple, entire sectors, industrial zones or value chains. The diverse and rich individual experiences and expertise of RECP service providers, contain valuable tacit knowledge to unlock this scale-challenge, yet such requires further structuring and operationalization into new scalable models, tools and strategies for implementation. As a modest first step, members of RECP net have started within their respective regions to map and integrate their respective expertise and knowledge, centered on priority thematic areas in their region, including for example: low carbon industry; industrial parks; life cycle tools; sustainable tourism; and RECP policy and strategy. A set of operational changes in the modalities of RECP net during 2015 are set to further transform RECP net from an instrument for implementation of the global RECP programme and related initiatives of the patron agencies and their donors to a multipronged and self-organized learning platform and source of inspiration and innovation for industrial resource efficiency.

INSIGHTS

A mind-map of intervention options has started to emerge to effectively incentivize enterprises to implement RECP, in short mainstreaming, and, to radically reduce the necessary efforts and associated transaction costs for efficient RECP implementation in enterprises, in short up-scaling. A first leverage point remains to nurture responsibility and put RECP on the agenda of governments and businesses alike, by furthering terminology, arguments and examples that closely resonate with businesses and their concerns combined with collective learning and social innovation, involving business leaders, media and law makers. A second lever concerns increasing enterprise rewards from RECP implementation, or - as the case might be - increasing the costs of and/or penalties from not doing so. This is ultimately an outcome of government policy and strategy, covering environment, industry and other policy domains, including implementation, monitoring and where necessary enforcement. Thirdly activities and impacts can be scaled-up with new intervention models that break away from the 'one-enterprise-at-a-time' intervention model that was required to demonstrate RECP benefits in the past. Scalable interventions models, for example, could possibly include: group based coaching of small businesses to implement RECP through self-assessment; cooperation in industrial parks to cover both enterprise-level and collective RECP options; sector based benchmarking and development and promotion of sustainable technology roadmaps; and value chain coordination and alignment. Embedding, as the forth potential leverage point, concerns the governance for and organization of RECP knowledge, capacities, roles and responsibilities within the country, with the challenge to facilitate and empower multiple initiatives, to meet differentiating needs of target groups, sectors and regions.

ILLUSTRATIONS

// UNIDO implements a regional RECP demonstration and replication programme for Armenia, Azerbaijan, Belarus, Georgia, Moldova and Ukraine, within the context of the European Union's Partnership Initiative for Environment and Growth, implemented by OECD, with input from UN Economic Commission for Europe (UNECE), UNEP and UNIDO. Taking on lessons learned from UNIDO's advocacy initiatives on Corporate Social Responsibility in Vietnam and from the Education for Sustainable Development initiatives of the United Nations University – Institute for the Advanced Study of Sustainability, a regional effort was launched to domesticate RECP to the respective country contexts. Consultative dialogues were held in each country to create a taxonomy for RECP in local language, and align with national environment, natural resource and business priorities, leading to primers setting the business case. Through regular thematic dialogues on key RECP themes it is foreseen to further advance awareness and understanding of RECP and indeed cultivate business responsibility for RECP. In parallel, each country is trialing RECP clubs to achieve uptake of RECP in groups of small businesses. The latter is making use of the experiences in the Republic of Moldova, where RECP Clubs were trialed with support from the Government of Austria in the municipalities of Chisinau, Causeni and Ungheni. A total of 71 small businesses completed one of the seven RECP clubs offered. Total

annual benefits achieved by these through no and low cost options only mounted up to USD 575,000, achieving annual energy savings exceeding 4,600 MWh, water savings in excess of 290 GJ and some 240 tons material savings.

// UNIDO engaged RECP*net* members and their associated experts to document a total of 33 examples of eco-industrial park development covering 12 countries (Cambodia, China, Colombia, Costa Rica, Egypt, El Salvador, India, Morocco, Peru, South Africa, Tunisia and Vietnam). Praiseworthy environment and resource conservation benefits were achieved in all, confirming the viability of the eco-industrial park concept in developing and emerging economies to scale up and mainstream RECP. Combining good practice elements from different cases, resulted in an integrated intervention agenda for eco-industrial parks. The five main intervention areas are: (i) plant level resource efficiency and cleaner production (traditional single company RECP application in all enterprises in the industrial park); (ii) collective resource efficiency (through use of wastes from one company by another company); (iii) shared environmental and utility services (for provision of steam, process water and or treatment of wastes and effluents); (iv) spatial planning and zoning (of the industrial zone as a whole); and (v) park management and operation, including transport and logistics. The balance of interventions should be matched to the industrial zone, including its mix of industries, ownership and stage of development. As a spin off several eco-industrial park pilot projects are now being further developed and implemented, under the RECP programme in particular in China and Indonesia, and with GEF funding in Vietnam, Peru and Thailand.



MOVING AHEAD

The first NCPCs were launched at about the same time as global manufacturing started to shift decisively to emerging and developing economies, environmental concerns still had predominantly a local and/or regional nature and potential risks of climate change only started to surface. The two decades since then have witnessed massive change: between 1995 and 2014, global population increased by 26%, global manufacturing value increased 77% and the share of manufacturing in global economy increased by nearly 1 %-point. Yet during the same period global material consumption increased by well over 50% and climate change became observable. Overall, (resource efficient and) cleaner production has become both necessary and urgent, much beyond what was anticipated at the launch of the NCPCs 20 years ago. And so has the global response.

The aspirational and transformative 2030 Sustainable Development Goals picture a world that is by 2030 significantly decoupled and getting robust in the face of changed and changing climate to realize the thematic goals and objectives in regard to: green economy; inclusive and sustainable industry, infrastructure and innovation; responsible consumption and production; energy, water and climate; and biodiversity and biological resources. Decoupling though remains abstract until industries and businesses invest in the development, production and use of new, resource efficient, low carbon and cleaner technologies, products and services, and in methods and techniques for reusing, recycling and/or recovering the remaining wastes and end-of-life products. The industry of the future, hence, is one that enables society at large to decouple, recover resources and adapt to climate change, whilst continuing to provide incomes and products and services that bring quality of life - a notion that is gradually gaining acceptance.

NCPCs, and alike initiatives, have been established in larger numbers than had initially been foreseen, and even more developing countries would like to start a NCPC. Whilst NCPC has remained as a trademark, the present operations of most NCPCs have evolved far beyond the initial model of a lean operation embedded in an established host institution. Time has taught that strong autonomous institutions are needed to amass the technical and operational know-how necessary to advice different industries, whilst also leading advocacy for RECP and leveraging policy change, technology transfer and clean technology investments. Moreover, NCPCs need to partner with government, business membership organizations, and research, innovation and education sectors in their home country to reach all industries, regardless of size, sector and/or location, and indeed bring customized and affordable RECP services closer to target enterprises to further lower the threshold for their utilization and indeed implementation of RECP.

The NCPCs have accumulated substantive knowledge and experience in fostering resource efficiency and cleaner production at enterprise level, and RECPnet is emerging as the platform for sharing and furthering such as a collective asset. Yet, a challenge of scale remains, as the tons and kilotons of resources saved and emissions avoided at enterprise level, still do not match the necessities to avoid these at the level of mega- and giga-tons. Adoption of RECP methods and techniques needs to step up both in pace and scale, to deliver towards the challenges of an inclusive and

sustainable future. There does not yet appear a panacea, even though, undoubtedly, working in more scalable models with groups of enterprises, industrial zones, value chains and/or sectors provides valuable starting points, along with greater emphasis for tailored advocacy and enabling policy for and supportive governance of RECP in the country.

INDUSTRY IN TRANSITION

Accelerated economic growth and poverty reduction have proven to coincide with industrialization. Further industrialization, therefore, remains important for developing and emerging economies to alleviate poverty, deliver goods and services, create jobs and raise living standards. Though, such should not consume materials, water and energy beyond sustainable supply levels nor emit toxins, pollutants and waste beyond the earth's absorptive capacity. Manufacturing indeed holds the key to unlock the decoupling challenge by developing and delivering decoupled products and services, enabling decoupled consumption patterns and lifestyles and driving decoupling through supply chains up to extractive industries.

Industrial production has shifted even more decisively to emerging and developing countries. The steel, cement, chemicals, paper and many others sectors are seeing vast growth of production in emerging and developing countries. World crude steel production doubled between 1995 and 2014 to 1.6 billion tons, 48% thereof in China. World chemicals sales, for example, doubled between 2002-2012 through a 50+% increase in tons of chemicals produced, signaling a change to higher value specialized chemicals. In this period, chemicals sales quadrupled in China, whilst decreasing by 40% in each of European Union, North America and Japan.

This rapid growth presents a challenge from environment and resource use perspectives. Yet in the global South it also presents an opportunity in that it offers the chance to prevent locking-in to environmentally damaging and inefficient production technologies, by adopting resource efficient and cleaner production techniques right from the start. By doing so, new industries will not only meet today's environmental standards, yes also be able to meet today's societal expectation and indeed likely future standards, and as such be 'fit-for-the-future'. This requires access to advanced RECP methods and technologies, advice and financing, including from members of RECPnet. Moreover, industries need further incentives, through policy change consistent across different sectors of government policy and including administrative measures and resources for implementation and enforcement.

SUGGESTED FURTHER READING

Kisch T., Ryden, E and T. Lindqvist, *Evaluation of the UNIDO UNEP National Cleaner Production Centres Programme*, International Institute for Industrial Environmental Economics, 1996

Luken, R., R. Van Berkel, H. Leuenberger and P. Schwager, *A 20 Year Retrospective of the National Cleaner Production Centres Programme*, in *Journal of Cleaner Production* (in press).

Luken R., and A. Navratil, *A programmatic review of UNIDO UNEP National Cleaner Production Centres*, in *Journal of Cleaner Production*, 12, 195-205, 2004.

SDC, *Report on Effectiveness 2014: Swiss international cooperation in climate change 2000-2012*, Swiss Development Cooperation, 2014.

UNEP, *Changing Production Patterns: learning from the experience of the National Cleaner Production Centres*, United Nations Environment Programme, 2002.

UNIDO, *Independent Evaluation UNIDO-UNEP Cleaner Production Programme*, United Nations Industrial Development Organization, 2008.

UNIDO, *Red Latinoamericana de Producción más Limpia: Informe 10 años*, United Nations Industrial Development Organization, 2013.

UNIDO, *Chemical Leasing: a global success story*, United Nations Industrial Development Organization, 2011.

UNIDO-UNEP, *Good Organization, Management and Governance Practices: a primer for providers of services in Resource Efficient and Cleaner Production*, United Nations Industrial Development Organization and United Nations Environment Programme, 2010.

Van Berkel, R., *Evaluation of the global implementation of the UNIDO-UNEP National Cleaner Production Centres Programme*, in *Clean Technology and Environmental Policy*, 13, 161-175, 2010.

Van Berkel, R., *Evolution and Diversification of National Cleaner Production Centres*, in *Journal of Environmental Management*, 91, 1556-1565, 2010.

PROGRAMME COUNTRIES

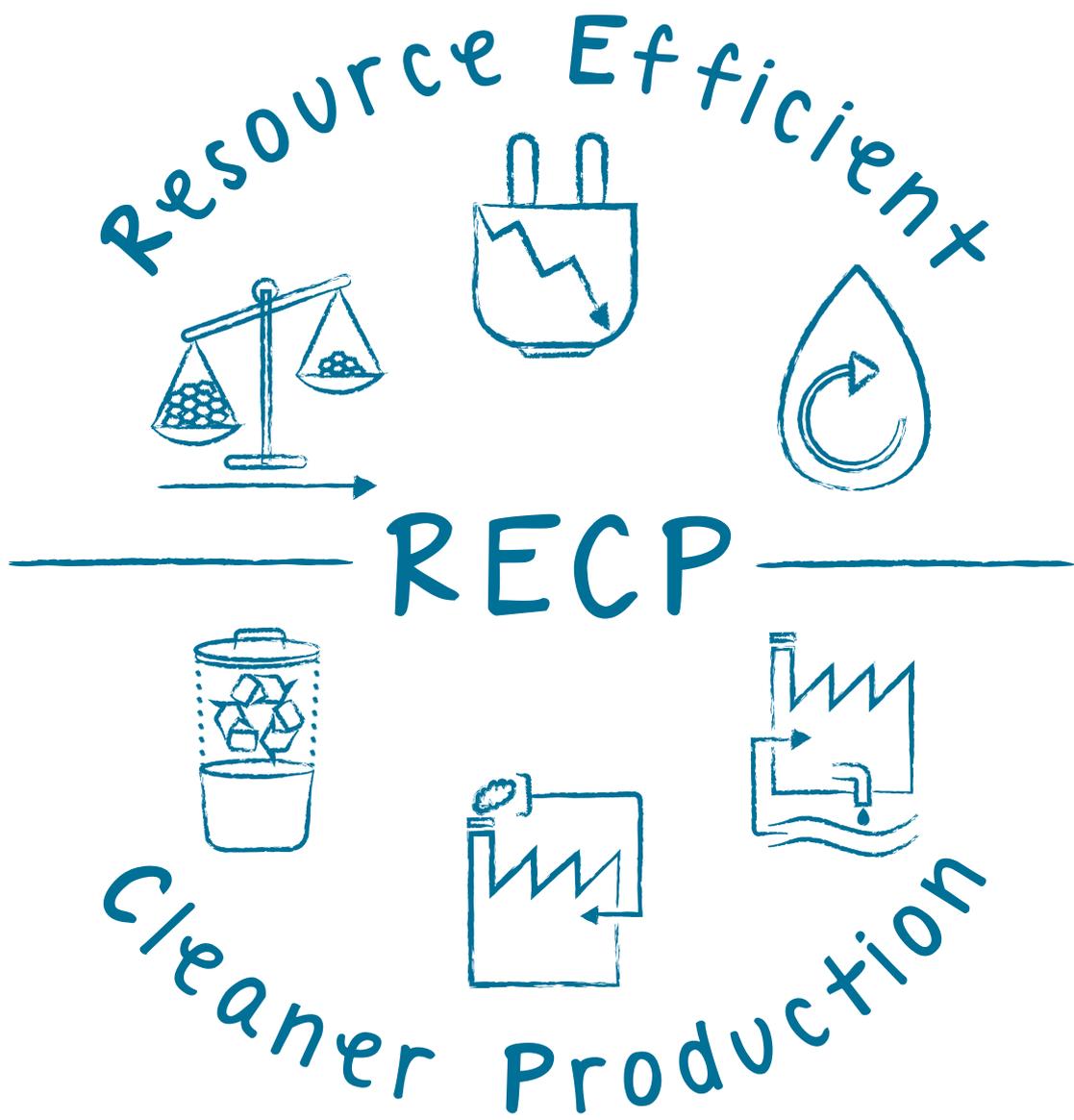
Albania	Kenya
Armenia	Lao PDR
Azerbaijan	Lebanon
Belarus	Macedonia
Bosnia Herzegovina	Mauritius
Brazil	Mexico
Bolivia	Montenegro
Bulgaria	Morocco
Cambodia	Mozambique
Cape Verde	Myanmar
China	Nicaragua
Colombia	Peru
Costa Rica	Republic of Moldova
Croatia	Republic of Korea
Cuba	Romania
Czech Republic	Russian Federation
Dominican Republic	Rwanda
Ecuador	Senegal
Egypt	Serbia
El Salvador	Slovakia
Ethiopia	South Africa
Georgia	Sri Lanka
Ghana	Tanzania
Guatemala	Tunisia
Honduras	Uganda
Hungary	Ukraine
India	Uzbekistan
Indonesia	Vietnam
Jordan	Zimbabwe

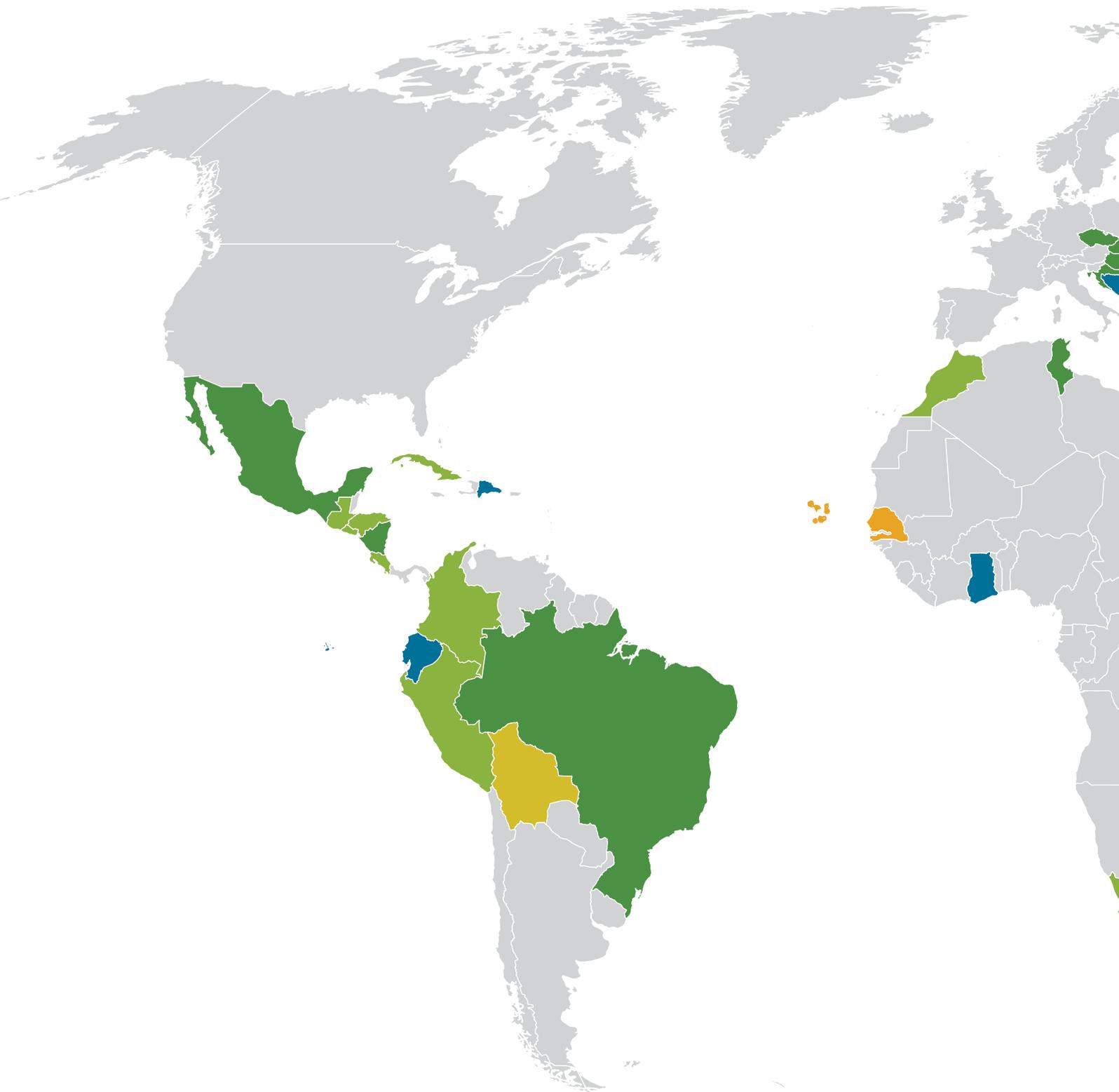
PROGRAMME DONORS

Austria
 Czech Republic
 France
 Germany
 Italy
 Japan
 The Netherlands
 Norway
 Slovenia
 Sweden
 Switzerland
 European Union
 Global Environment Facility
 MDG Achievement Fund
 One UN Fund
 United Nations Development Programme

KNOWLEDGE PARTNERS

- Aeuquilibrium, Switzerland
- Buro for Integrierte Problemlosungen, Germany
- BSS Basel, Switzerland
- Carbotech, Switzerland
- CSD Ingenieure, Switzerland
- Denkstatt, Austria
- Danish Technical Institute, Denmark
- Danish Technical University, Denmark
- Eco-Efficiency Group, Australia
- EMPA – Swiss Federal Laboratories for Materials Science and Technology, Switzerland
- Erasmus Centre for Environmental Studies, The Netherlands
- First Climate, Switzerland
- Gruetter Consulting, Switzerland
- Infrac, Switzerland
- IVAM Environmental Research, The Netherlands
- International Institute for Industrial Environmental Economics, Sweden
- Johanneum Research, Austria
- University of Applied Sciences and Arts - North Western Switzerland, Switzerland
- Neosys, Switzerland
- Sustainable Business Associates, Switzerland
- SOFIES, Switzerland
- STENUM, Austria
- Stocker Group, Switzerland
- Technical University of Delft, The Netherlands
- University of Massachusetts at Lowell, USA





National Cleaner Production Centres have been established and are supported by the United Nations Industrial Development Organization and the United Nations Environment Programme, in cooperation with the global network for Resource Efficient and Cleaner Production (RECPnet). This publication was made with the generous support of the State Secretariat for Economic Affairs, Government of Switzerland.



UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Industrial Resource Efficiency Unit
PO Box 300, A1400 Vienna, Austria
www.unido.org/cp
recpnet@unido.org



UNITED NATIONS ENVIRONMENT PROGRAMME
Division of Technology, Industry and Economics
15 Rue de Milan, 75441 Paris Cedex 09, France
www.unep.fr
uneptie@unep.org



Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Swiss Confederation

Federal Department of Economic Affairs FDEA
State Secretariat for Economic Affairs SECO