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UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org

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Background Paper

National Strategies for Cleaner Technology Transfer

by

Viera Fecková
Slovak Cleaner Production Centre

ROUNDTABLE III

Waste Management, Recycling Schemes and Related Technologies

INTRODUCTION

Efforts to integrate with the European Union, during a transition period of economical, political, and social changes, mean unusual challenges for countries in the region.

Companies are under increasing competitive pressure of market economy, while faced with shortage of capital, tougher environmental legislation and limited access to information.

Nations have to address many problems including legal systems; brain drain, unresolved environmental problems from the past, new social issues and many other problems.

Further pressures on governments and state budgets are generated by:

- The need to compete in one of the most advanced markets: the European Union, and in the same time to withstand its pressure;
- Efforts to join international organisations such as OECD, European Union, NATO;
- Consequent demands to harmonise country's internal conditions with international standards

A continuing challenge is how to use national resources to support technology-related development. Global competitiveness requires the establishment of strategic advantage through specialisation. By focusing on those areas in which there is a good match between global opportunities and a countryás strengths in science and technology, resources can be deployed where they can make the greatest impact.

This paper is based on work of the project implemented by Slovak Cleaner Production Centre and ministry of Environment in cooperation with UN DSD/DESA. The methodology for country diagnostic study preparation as a background for national strategy was developed and applied.

The methodology could be used by countries in the region to analyse capacities and opportunities for research, development and commercialisation of cleaner technologies in the country.

CLEANER TECHNOLOGIES

Cleaner technologies for the purposes of this paper, as well as presented project, are intended to be technologies that:

- Conserve raw materials and energy, reduce the toxicity (or hazard) of the materials used in a process; reduce the quantity and/or toxicity (or hazard) of industrial processes' wastes and emissions.
- Produce products (and their packaging) that consume less materials and less energy during use, generate less emissions and waste, are more easily reusable, recoverable or recyclable after use, and have less impact if deposited in the environment.
- Produce services that consume fewer materials and less energy during their deployment and/or generate less emissions and waste during their deployment.[1]

Technologies for the purposes of this paper refer to "not just individual technologies, but total systems, which include know-how, procedures, goods and services, equipment as well as organization and managerial procedures"[2]. So we do not refer only to the hardware part of technology. In EU the term “techniquesáis often used.

New technologies must be generated and defined for the purpose of achieving progress in the development priorities of each country. Economic and social development continues to be the priorities in countries of this region. However, this emphasis on the economic and social aspects of development must be reconciled with concerns over the impacts that these development goals may have on the environment and thus on the countryás ability to maintain development in the long term.

[1] UNIDO
[2] Agenda 21

NATIONAL CLEANER TECHNOLOGY STRATEGY

Long-term studies in many countries suggest that advances in technology have been responsible for at least half of long-term economic growth, through improvements in capital and labour productivity, and the introduction of new processes, products, and services. "Studies also show that a high percentage of the technologies used in the region are not generated domestically. Not one of the countries in the region can be said to have maintained sufficient internal capabilities for scientific development and technological change to sustain capital formation and managerial skills; to link knowledge and production; and, most importantly, to penetrate international markets by systematically increasing the ability to compete. While accepting the universality of scientific knowledge, we must recognize that world advances in science are driven mainly by economic objectives. The fundamental directive of policies in the areas of science and technology must be geared to the regionás current and future needs.

Some countries have started to develop national technology strategies in order to promote technological advances and sustainable economic growth together with environmental protection. Such **National Cleaner Technology Strategies (NCTS)** could be an important component of development policies.

NCTS generally focus on three complementary goals:

(i) To build industries that are competitive in both domestic and global markets, as well as environmentally sustainable;

(ii) To establish business conditions attractive to domestic and foreign investments in cleaner technology, and bringing in international technology, finance, and managerial know-how; and

(iii) To promote public-private R&D partnerships aimed to encourage spin-off, adaptation and commercialisation of cleaner technologies, through investments in productive assets that remain within the countries.

The development of market-oriented NCTS is an important complement to market reforms, promoting adaptation of R&D institutions and publicly owned and private industrial enterprises toward new domestic and global market opportunities as well as EU accession.

Because of lack of resources for R&D activities, countries need to attract foreign investment and foreign companies as partners. Private sector spending, including foreign participation, can be leveraged by modest but well-targeted government support. Work in the area of cleaner technologies is relatively recent in developing countries, in part due to the fact that environmental protection is often seen as limiting economic growth. **In fact cleaner production often increases productivity and reduces waste, contributing to long-term economic growth**.

GOVERNMENT INVOLVEMENT

The purpose of the methodology is to provide strategic planning tools for policy makers in these countries. These tools are aimed to aid policy makers in merging all three priorities, social, economic and environmental, into policies which will use science and technology to achieve an organic linkage between research and production to improve the countryás ability to use its natural resources efficiently and protect the environment, while raising living standards and promoting exports to achieve economic development.

The methodology is intended as a starting point for a continuing process of study and practical testing of national cleaner technology strategies.

The objective of the methodology is to encourage governments to develop and implement National Cleaner Technology Strategies aimed at promoting research, development, transfer and commercialisation of cleaner technologies on the basis of partnerships with domestic and foreign private companies to promote the modernization of national industries.

These policies should aim to strengthen the countryás research and development capacity, to improve the competitiveness of key industrial sectors and to integrate technology policies into overall sustainable development plans.

A National Cleaner Technology Strategy should provide technology policy options to promote the development of sectors where a countryás "opportunitiesáand "capacitiesámeet. These policies should aim to:

- Stimulate the creation and commercialisation of cleaner technologies
- Establish institutional arrangements to improve the effectiveness of public investments in R&D returns on public investment, as well as the commercialisation of publicly-owned technologies
- Improve the research and development capacity of the countryás universities, public research institutions and industries
- Improve the application and commercialisation of existing research results
- Create new high-wage, high-skilled job opportunities
- Make national industries including small and medium-sized producers and recently privatised enterprises competitive in the global economy as well as environmentally sustainable
- Build a financial-technical network willing to invest in and support technology-based enterprises at each stage of development
- Provide incentives for foreign and domestic investment in national R&D and for improving the existing industrial base

Partnerships between public and private, and national and international actors must be strengthened.

Government agencies can promote these objectives by:

- Establishing processes to make partnership opportunities more accessible and easier to identify for both national and international participants
- Establishing efficient and reliable access to information
- Establishing mechanisms to match projects and cleaner technologies with sources of capital, both domestic and foreign, and other technical and commercial support to facilitate the commercialisation process
- Improving cooperation among government entities, the private sector and potential foreign investors
- Using public funds to leverage increased inter-sectoral coordination or research activities
- Promoting the use of consortia and other umbrella organizations to multiply efforts and offer firms of all sizes opportunities to participate in R&D
- Ensuring the effective protection of intellectual property and investor rights
- Promoting simple, clear, transparent and predictable procedures for royalty and licensing agreements
- Ensuring that public-private partnership agreements are responsive to private sector needs and easy to negotiate
- Increasing private sector participation in policy making and project selection
- Developing a system for measuring programme results

METHODOLOGY FOR THE DIAGNOSTIC STUDY

The diagnostic study should assess sectors on which a country could focus its attention for technology related economic development in an increasingly environmentally conscious world. This is the first step toward the development of an action plan identifying specific technologies for priority development. The study relates global and national opportunities in specific technologies to the capacities of businesses, government, and research institutes and universities in the country to capitalize on these opportunities. International and national data are to be collected on a range of variables related to selected sectors and where possible to technology areas. Each of these variables will be evaluated by means of performance scores for each sector and potential technology area. The study will conclude with a summary assessment of where the best matches lie between high opportunity sectors and technologies and high domestic capacity.

For the purpose of the diagnostic study a list of sectors and technologies for consideration has to be created. The critical technologies concept can be used as a starting point to identify technologies that are most relevant to the country.

Those sectors/technologies, which:

- have either high rate on the countryás GDP or
- are an important employer or
- are important within the country from other point of view (c.f.e.: high received investments during last few years), or
- are already seen as priorities in official policies

should be included in the analysis.

Within the analysis process, the systemic business approach is adopted: to examine the current situation in through analysis of past data and future projections. To identify which technologies may be priorities for a country, one must understand both external and internal environments: in economic (including market), environmental and social dimensions.

The internal environment describes the countryás "*capacityá* or capabilities to take advantage of these opportunities in scale of "Strengthsá and "Weaknessá whereas the external environment is viewed as a range of "Opportunities" and "Threatsá in further text referred as "*opportunitiesá*

Technologies in which both *capacity* and *opportunities* are judged to be high would be candidates for further study as strategic technologies.

A set of indicators should be designed which would reflect the most important facts Three groups of indicators would apply:

- national - indicators which are not specifically related to the sector or technology, but are expected to have important impact to the final development and rate of sector specific value to the national one would be of interest. GDP and GDP growth, usual interest rates of mid- and long-term investments, energy prices, infrastructure indicators are few examples;
- sector specific - indicators specifically related to and/or evaluated for the sector;
- technology/technology area specific - indicators specific to the certain technology area/sub-areas. Technology specific raw material pricing, typical investments per employee, specific resources (water f.e.) consumption per unit of production, are few examples.

Some indicators would apply to more than one sector, for example in cases when several sectors/technologies share the same specific resources. Indicative list is in ANNEX I.

To the extent possible, data collected and analysed should apply to particular sectors so that the analysis will be consistent. Technology specific indicators are typically available in limited extent, though it would be desirable to have an opportunity to collect them. Most of them are not part of statistics.

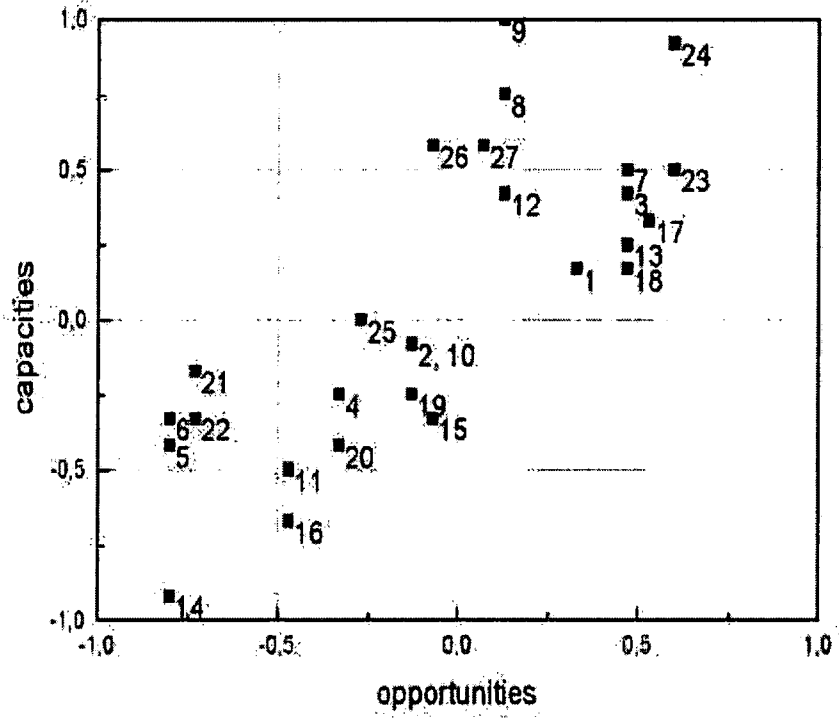
Collected data are assessed and weighted in a systemic way described by methodology.

EXAMPLE RESULTS FOR SLOVAKIA

A national case study analysed the situation in Slovakia to provide policy options, as a practical example of the application of the methodology.

In the chart below, the cells in the upper right show those technology areas with the most promise for Slovakia. A similar chart can be prepared for each country. The reader should keep in mind that this chart is intended as a guide to thinking about these technologies rather than a definite statement about the prospects for that technology.

Those areas, where both numerical values are positive show potential for further considerations within the process of preparation of NSCT. Those technology categories, where both numbers are higher than 0,5 should be considered as first priority.



1 Energy efficiency
2 Energy storage, condition
3 Improved generation
4 Monitoring and assess.t
5 Pollution Control
6 Remediation and restorat.
7 Communications
8 Computer Systems
9 Information management
10 Intelligent complex adap
11 Sensors
12 Software and toolkits
13 Biotechnology
14 Medical technologies
15 Agriculture & food techn.
16 Human systems
17 Discrete product manufac.
18 Continuous material proce.
19 Materials
20 Control
21 Propulsion and power
22 Systems integration
23 Car production
24 Light chemistry
25 Wood and furniture
26 Pulp and paper
27 Polygraphy

Conclusion

The final analysis should consider a broad range of variables and develop an overall assessment of technologies, talking into account, where necessary, factors not considered in the methodology.

The results of methodology applied will depend on selection of factors and criteria and their weights. For this reason, the team-work of experts involved, as well as valid data are crucial for results.

The methodology needs to be recognized for what it is, a preliminary framework for an overview assessment. The assessment will be a diagnostic study of cleaner technology capacities and opportunities for commercialisation in the country. The next step should be to develop a broad strategic plan utilizing this assessment and implementing the plan through strategic technology policies for the country.

ANNEX 1

Examples of indicators which could be considered in the study.
The two types of indicators are seen: sector specific (S) and common (C).

ID	*Description of indicator*	*Type*	*Note*
1	Research and development spending as a percentage of GDP per sector.	S	3,4 5
2	Sector annual growth rate in total R&D expenditures.	S	1,3
3	Total R&D personnel (science and engineering) per 1000 labour force.	C, S	1
4	Sources of R&D expenditures at public universities: national government, local government, industry, institutions and others. Latest year available. Total $ and %.	C	1
5	Share of total R&D expenditures by government, industry and academia..	C	1, 3
6	Sector research institutions involvement in national and international projects	S	1, 2
7	Level of R&D spending by international projects/programs in the country by sector	S	
8	Total national investment in R&D by sector.	S	1, 3
9	Ranking of the country's and other regional R&D universities. Latest year available. Rank by total of all R&D expenditures.	C	1
10	Dollars invested in nationally designated university research.	C	1, 2, 3
11	The countryás industry R&D investments by sector.	S	1, 3
12	Intellectual property protection number of inventions, patents, licences awarded by category/sector	S	1, 3
13	Leading technology classes/sectors on patent awards. Totals and ratio of national patents by	S	1, 3
14	Leading technology classes/sectors among licences. Totals by category/sector.	S	1, 3
15	Patents registered, by sector, for the last 5 years, with percentage breakdown per category.	S	1,2
16	Science and engineering graduate students per million inhabitants for the latest year available.	C	1, 2
17	Employment and job creation in manufacturing and other selected technology sectors. Comparative analysis of the last 5 years. Share of total employment and net job creation.	S	1
18	Employment structure and wages in manufacturing and other selected industries. Latest year available.	S	1

1 national data

2 EU, OECD, selected countries, USA data

3 latest year, comparative changes for the last 3-5 years, depends on data availability

ID	Description of indicator	Type	Note
19	Sectoral strengths and key industries. Employment and number of firms. Latest year available.	S	1
20	Number of scientists and engineers working by sector.	S	1, 2
21	Unemployment, inflation, national savings, and investment trends and growth for the last five years, as well as estimates for the future.	C	1
22	Rate of university degree employees speaking at least one foreign language	C	1, 2[6]
21	Rate of households having access to Internet	C	1, 2
22	Per capita GDP growth for the last 5 years.	C	1
23	Sector growth as a percentage of GDP	S	1, 2
24	Total exports in dollars and as a percentage of GDP by export category for the latest year available.	S	1
25	Evolution of the budget deficit (last 5 years).	C	1
26	Venture capital invested in companies, by sector, for the last 5 years.	S	1, 2
27	Total capital investments by technology category/sector; in percentages and local currency.	S	1, 2
28	Capital investments á machinery and equipment - by category/sector, in local currency and in percentages of total capital investment by sector	S	2
29	Capital investment á nonmaterial investment á by category/sector, in local currency and in percentages of total capital investment by sector, for last 3 years	S	2
30	Participation of foreign capital in sector in % of foreign capital in country	S	1, 2
31	Average interest rate development	C	1, 2
32	Number of ISO 14001/EMAS compliant firms and ratio of ISO compliant firms to potential registrants for the latest year available.	C	1
33	Number of ISO 14001/EMAS certified companies, by sector.	S	1, 2
34	Government data on mineral and natural resources production capacity (i.e. tons of cement per year, m^3 of natural gas per year, etc.).	C	1
35	Average energy, water prices by sector	S	1, 2
36	Wastes and emissions fees collected by sector	S	1, 2
37	Primary resources consumption (energy, water, etc.) by sector	S	1, 2
38	Presence of subsidies on water, gas, electricity, heat, etc. for sector	S, C	1
39	BCL (Basic capacity level defined by OECD) for CP reached in the country	C	1
40	Direct support to CP by sector	S	1

1 national data

2 EU, OECD, selected countries, USA data

3 latest year, comparative changes for the last 3-5 years, depends on data availability

ID	*Description of indicator*	*Type*	*Note*
41	Sector specific environmental best practice experience (guides, CP case studies, environmental performance benchmarks recommended, etc.) acquired nationally	S	1
42	Presence of environmental WG or other activity within the sector industry association	S	1
43	Sector regulated by IPPC Directive	S	1
44	Average consumption of natural resources per unit of production (water, energy, gas) by sector as a % of those identified by BAT/sector guide or World Bank guide	S	1
45	Sector specific environmental regulation and enforcement by sector	S	1

1 national data

2 EU, OECD, selected countries, USA data

3 latest year, comparative changes for the last 3-5 years, depends on data availability