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The System for Cleaner Production Innovations Development and Implementation in Industry (APINI – SPIN)

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Abstract

The role of industry in the process of sustainable industrial development is obvious. It relates to changes in production processes, products and services aimed at reduction of impact to the environment in the entire life cycle perspective that result in improvement of environmental, economic and social performance of enterprises. To ensure sustainable industrial development, a systematic application of the following measures is needed:

- Cleaner production (CP);
- Environmental and integrated management systems;
- Product related measures of sustainable industrial development (e.g. eco-design, life cycle approach); and
- Sustainability reporting.

CP should be an essential part of any comprehensive environmental management system at enterprise or national level. In many cases, the adoption of CP improvements can reduce or even eliminate the need for end-of-pipe investments and can bring both environmental and economic benefits. Experience shows that companies having identified cost-effective and technically feasible CP options, may still not be able to make necessary CP investments to realize the financial benefits and environmental advantages. Financing of CP projects varies among countries and types of the projects. Domestic and international efforts to strengthen environmental financing still face a number of serious obstacles, many of which related to profound economic, political and social problems.

In 1997, the Institute of Environmental Engineering (APINI) developed a system for CP innovation development / implementation. The system consists of the pool of experts (on CP innovation generation, financial engineering, implementation and monitoring), the financing source – soft credit line at Nordic Environment Finance Corporation (NEFCO) and industrial companies. The system is based on the company's material and energy flows, and properly evaluated environmental costs based on Environmental Management Accounting (EMA). The methodologies employed in the system are flexible, can be applied to different company levels and enable decision–maker to obtain information in terms of the intended economic and environmental purposes. The system has been used for development of 141 innovations in 69 Lithuanian industrial companies. These innovations enabled reduction of energy consumption by 30 365 MWh/year. APINI experience was successfully disseminated in Africa, South East Asia, Central America, and Central and Eastern Europe.

This article presents an overview of activities and experience of APINI in development of CP innovations in industry and lessons learned in terms of strengthening corporate commitment in sustainable development.

Keywords: Cleaner Production, Preventive Innovation, Material and Energy Balance, Environmental Management Accounting, Environmental Financing

1 Introduction

Cleaner Production (CP) is recognised and proven strategy for improving the efficient use of natural resources and minimising waste, pollution and risks at the source where they are generated. CP should be an essential part of any comprehensive pollution management system at an enterprise or national level. In many cases, the adoption of CP improvements can reduce or even eliminate the need for end-of-pipe investments and can have both environmental and economic benefits (Staniskis et al. 2002).

The Institute of Environmental Engineering (APINI) (EU Centre of Excellence in Sustainable Industrial Development (APINI – SID)) initiated implementation of CP concept in Lithuania and is the main institution in the country working in this area. In 1992-2007, with support provided by different donors and in co-operation with different foreign and local partners APINI supported more than 150 Lithuanian companies to implement CP projects.

In Lithuania, CP Basic Capacity Level (BCL) was achieved in 1998. During CP programmes, capacity of local consultancy and training partners was built and enabled them to take over and to conduct training / consulting with minimum support from abroad (Staniskis et al. 2002).

As APINI experience shows, companies that have identified cost-effective and technically feasible CP options, often may still not be able to make the necessary investment to realize the financial benefits and environmental advantages (Staniskis et al. 2003). To facilitate implementation of CP options that require investments, a special revolving fund was established by Nordic Environment Finance Corporation (NEFCO) in 1998. The main objective of the fund is to provide soft loans for the implementation of high-priority CP investments with rapid payback that yield environmental and economical benefits. The revolving fund became an important part of the unique and very effective APINI SPIN system for CP innovation development and implementation.

2 Methodology

A scheme of APINI SPIN system for CP innovation development and implementation in industry is presented in Fig. 1.

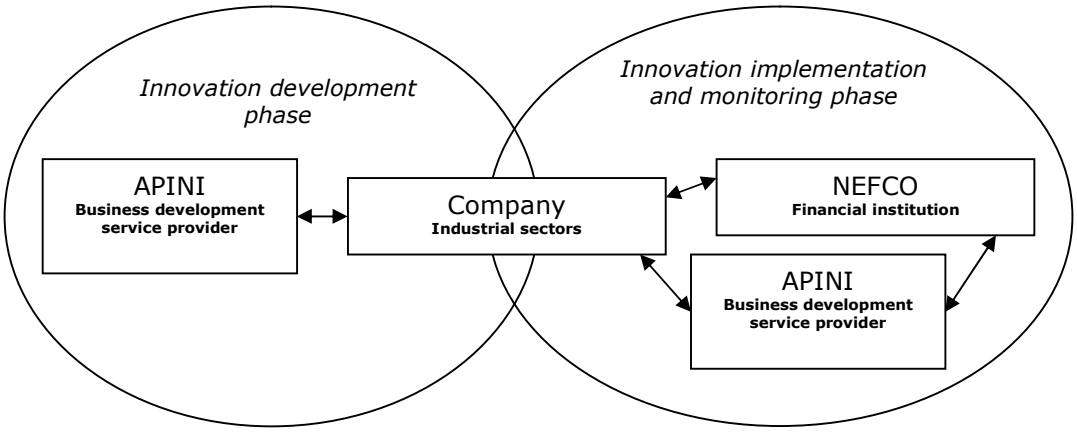

Fig. 1. APINI SPIN system for CP innovation development and implementation in industry

APINI – is the key executive of the system. APINI assists a company in CP innovation development and assessment in accordance to the methodology, preparation of investment project and loan application; assists NEFCO in communication with the applicant and development of the loan documentation; develops implementation progress and completion reports to be presented as a part of NEFCO disbursement requests, performs monitoring.

NEFCO – finances on favourable terms the implementation of CP innovation; performs primary environmental, technical and economical evaluation of the innovations based on data provided by APINI; verifies whether the project has achieved its overall environmental and economic goals with an economic post-evaluation.

Company – provides data, documents and technical experience to APINI; provides APINI and legal company the collateral for the loan security; signs the contract with NEFCO; provides information on the innovation implementation monitoring, environmental and economic data during the pay-back period (once a year) to APINI; ensures project implementation in accordance to the loan conditions.

The steps of CP development methodology are described below. The process is divided into four phases :

1. *Planning and organisation.* The process:
   - ensures the selection and implementation of the most cost-effective preventive options;
   - consistency of the objectives and activities with those identified in the organisation's broader planning process;
   - facilitates broader investment analysis and decision-making.
2. *Assessment.* The objective of the phase is selection of one or a few innovation options. While doing so, first inventories of obvious options as well as a preliminary estimate of the waste generation costs are made. Afterwards, the phase focuses on the production processes that involve waste streams and is based on examination and re-evaluation of the production processes. The re-evaluation consists of "source identification" followed by "cause diagnosis" and "option generation".
   - For the *source identification*, an inventory is made of the material flows entering and leaving the company, including the associated costs. This results in a process flow diagram, allowing the identification of all sources of waste and emission generation and connection to the sources, pathways and intermediate / final sinks of the materials (Stasiskiene et al. 2006).
   - The next step *(cause diagnosis)* is based on the material and energy balance and investigates the factors that influence the volume and composition of the waste and emissions generated.
   - The purpose of the *option generation* is to create a vision of how to eliminate or control each of the causes of waste and emission generation.
3. *Feasibility studies.* These studies have to prove whether each of the selected options is technically and economically feasible and whether each option contributes to the environmental improvement.
   - Technical evaluation consists of two interrelated parts. First, it should be evaluated whether the option can be put into practice, i.e. to check the availability and reliability of equipment, the effect on product quality and productivity, the expected maintenance and utility requirements and the necessary operating and supervising skills. Second, the changes in the technical specifications can be converted into a projected material balance reflecting the input and output material flows, and energy requirements after implementation of the preventive innovation.

- The economic evaluation consists at least of data collection (regarding investments and operational costs as well as benefits), choice between evaluation criteria (payback period, net present value (NPV) or internal rate of return (IRR)) and feasibility calculations (Millichamp 1997). The economic data collection is based upon the results of the technical evaluation. To incorporate properly the long-term economic advantages of preventive innovation, Environmental Management accounting (EMA) principles to the economic evaluation are applied (Stasiskiene et al. 2006).
- The objective of environmental evaluation is to determine the positive and negative impacts of the innovation to the environment. To be comprehensive, an environmental evaluation must take into account the whole life-cycle of a product or service. The following steps can be used (Staniskis et al. 2001):
  - Evaluate changes in: (i) quantity and (ii) toxicity of wastes/emissions in all their life-cycle stages (at least in terms of raw materials, production, use and disposal).
  - Evaluate changes in energy consumption throughout the life-cycle.
  - Determine whether the environmental effects will be shifted to other media.
  - Determine whether there will be a change in the re-usability of this or other waste streams.
  - Determine whether the degradability of the wastes/emissions will be changed.
  - Determine the extent to which renewable raw materials can be used.
  - Determine the extent to which energy consumption can be reduced.
  - Determine the extent to which renewable energy sources can be used.

4. *Implementation and continuation.* The feasible CP is implemented and provisions taken to assure the ongoing application of new innovations. The development of such ongoing programme requires the monitoring and evaluation of the results achieved by the implementation of the first batches of prevention innovations. The expected result of this phase is threefold: (i) implementation of the feasible preventive innovations; (ii) monitoring and evaluation of the progress achieved by the implementation of the feasible options; and (iii) initiation of ongoing preventive activities.

CP innovations developed in accordance to APINI SPIN have mainly been used to reduce energy and water consumption and to minimize pollution (see Fig. 2 and Fig. 3). In terms of innovation type, most of investments have been used for process optimisation and technology change.

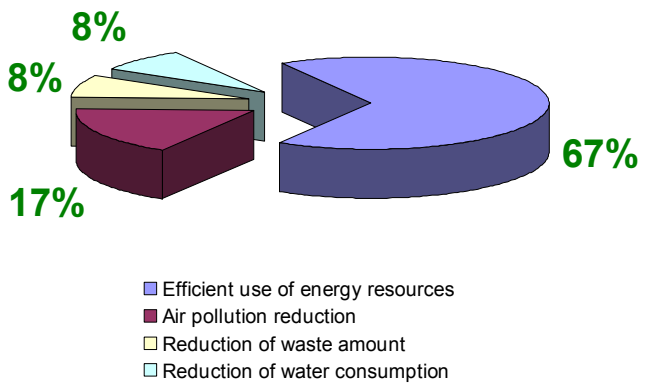

Fig. 2 APINI SPIN: Implementation of preventive innovations by environmental

areas

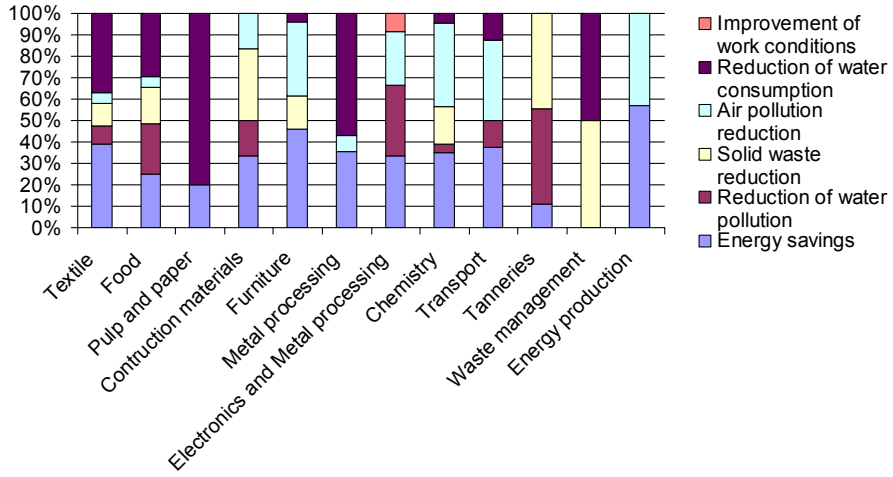

Fig. 3 APINI SPIN: Preventive innovation areas in Lithuanian different industries

The results of the system are stored in a data base "Implementation of Cleaner Production in Lithuania", which is created by APINI. The data base is updated periodically (twice a year).

3 Conclusions

Very important assumption of Basic Capacity Level (BCL) concept is that economic approach for CP cannot be effective until the BCL is achieved due to the following reasons:

1. Little demand from industry for CP implementation; and
2. Very little assistance available from national CP experts.

When BCL for CP is created, the country should designate its own national development strategy based on needs and experience - national and international (Huhtala et al. 2003). It should be stressed that two types of activities - *political* (efforts to reform tax policies, use of market based instruments, regulatory policy, education and other tools that motivate decision makers to select CP from available choices) and – *industry based* (specific environmental projects, technical assistance and direct financing of environmentally sound projects in industry and organisations) should be integrated.

APINI SPIN promotes development, financing and implementation of preventive innovations in industry aimed at efficient use of energy, use of alternative energy resources and minimization of pollution to air, water and soil.

The system is successful due to innovative aspects:

1. APINI SPIN system is based on preventive strategies;
2. The process of innovation generation and implementation from the very beginning is performed by researches and industry together;

3. Sophisticated „one stop shop" system – it comprises innovation generation, assessment, financing, implementation and monitoring stages.

According Cost/benefit analysis and environmental compatibility the system results on implemented preventive innovations in Lithuania (1997 – 2007) are the following:

Number of companies	69
Number of implemented preventive innovations	141
Environmental results (yearly):	
El. energy consumption reduced	30 365 MWh
Heat energy consumption reduced	60 510 MWh
Waste amount reduced	86 700 t
Chemicals consumption reduced	850 t
Air emission reduced	79 500 t
Drinking water consumption reduced	297 500 m^3
Diesel consumption reduced	387 000 l
Natural gas consumption reduced	5 883 000 m^3
Petroleum consumption reduced	656 800 t
Wastewater amount reduced	622 500 m^3
Industrial water consumption reduced	468 900 m^3
Economic benefit:	
Total investment in preventive innovations	16 529 000 EUR
Yearly savings from preventive innovations	9 605 000 EUR

Also APINI SPIN possess replication potential: it was successfully presented/applied in the frame of UNEP, UNIDO and EU projects in companies in Zimbabwe, Tanzania, Vietnam, Uganda, Nicaragua, Guatemala, China (Liaoning province), Russia and CEE.

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