

CLEANER PRODUCTION AS A DRIVER OF GREEN COMPETITIVENESS¹

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In the modern condition the cleaner production is a necessary component for achieving sustainable development. Promotion of the company's green competitiveness impossible without implementation the green technologies and cleaner production. The purpose of the paper is generalizing the main approaches to understanding the cleaner production given the opportunity to emphasize its key elements. Authors underlined the main targets of cleaner production. For promoting better understanding of cleaner production among companies the nine guiding principles were formulated. The main spheres where principles have to work: products and packaging, services, wastes, ecologically incompatible byproducts, energy and materials, technologies, and work practices, work places, security and well-being, communities around work places. They connected with the all stage of production and commerce process. In the paper determined corporate strategies for successful implementation of cleaner production. The key elements of strategies are efficiency and implementation of renewable energy technologies. In the paper authors generalized the main spheres cleaner production. The author emphasizes that the implementation of cleaner production practices need a wide understanding of the necessity of their development and providing across the society. Thus, the co-benefits of its promotion are increased productivity, established employer moral and green ethics, improved competitive positioning, enhanced green corporate image and companies' reputation. Author emphasises that cleaner production promotion has to include activities connected with raising stakeholder's environmental awareness, compilation and dissemination of up-to-date information on cleaner production practices and green technologies; human resources development; providing demonstration projects in different sub-sectors and locations in the country. Generalizing the scientific background about the perspectives and challenges of cleaner production implementation give the opportunity to formulate the main barriers of cleaner production development.

Keywords: pollution, cleaner production, sustainable development, economic development, environmental impact, strategies, benefits.

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INTRODUCTION

Cleaner production (CP) is an integral, necessary component for achieving sustainable development. By eliminating or reducing waste at the source, economic development can continue to occur, but in a more environmentally sustainable manner. Cleaner production is a specific approach to reduce industrial environmental impact. The origin of the approach is to be found in the American company 3M. In 1975 3M initiated its 3P-program: "Pollution Prevention Pays" program. The philosophy of the program was that any waste produced during the production process is to be regarded as a misallocation of input materials. The 3M-3P-program was designed to work through the inputs of the employees. Employees were encouraged to report options that could reduce waste and emissions and could save money at the same time. The company promised that any option that would reduce costs would be implemented and the employee would receive a reward for reporting the option. In this way 3M was able to reduce considerable amounts of waste and considerable amounts of costs at the same time (Dieleman, 2007).

The goal of the paper is generalizing the main approaches to understanding the cleaner production given the opportunity to emphasize its key elements

LITERATURE REVIEW

The scientific experience has a lot of researches about the role and importance of cleaner production in the global and government levels. The wide range of the scientists analysed the

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challenges connected with economic (Abaas et al., 2018; Bilan et al., 2018; Chygryn et al., 2018b; Vasylyeva et al., 2013, 2018; Leonov, 2018), financial (Chygryn, 2018a; Vasilyeva et al., 2016; Cebula et al., 2018), organisational (Bilan et al., 2019a), institutional (Bilan et al., 2019b, Rosokhata, 2020b) preconditions of cleaner production promotion. In the articles (Kargol-Wasiluk et al., 2018; Mihóková et al., 2017; Tommaso, 2018; Kouassi, 2018; Kowo, 2019), the authors analysing innovation and fiscal and social factors on sustainable development at the different levels of management. The articles (Fogarassy, 2018; Androniceanu, 2017; Vargas-Hernández, 2018; Macaityte, 2018; Pimonenko et al., 2018, Rosokhata, 2020a, Chygryn, 2011) highlights the importance of implementation and using the modern tools of cleaner production. The authors in the papers (Chygryn, 2015; Chygryn, 2019; Vasilyeva, 2019; Sjaifuddin, 2018; Balkytė et al., 2010a, 2010b;) analysed the impact of environmental factors on achieving SDGs in different sectors of economy.

RESULTS

The concept of CP was developed during the preparation of the Rio Conference. UNEP (United Nations Environmental Program) developed in 1991 the often cited definition, where CP defined as the continuous application of an integrated preventive environmental strategy to processes, products, and services to increase efficiency and reduce risks to humans and the environment. It was meant to reduce the environmental impact of industry and built among others on ideas from the 3P concept (pollution prevention pays). Whereas sustainable development is a goal for a wide array of target groups (population, consumers, businesses, among others), CP is directed to business, industry (processes, products) and service. The original definition points primarily to technical aspects: CP strategies are fundamentally concerned with operations, environmental sustainability and maximization of waste reduction, recycling, and reuse at the enterprise level, and are thus micro economic in scope” (Khalili, 2015; Popoola, 2018).

Dealing with environmental problems caused by industry in the 1970s put emphasis on pollution abatement, treatment of emissions and effluents using so called end-of-pipe techniques before releasing to the environment. The costs of the control of industrial pollution and of monitoring compliance with the even more stringent legal requirements increased continuously and for industrialized countries typically reached 0.8 to 1.7% of the GNP over the period 1972-1986. During the second half of the 1970s the concept of low and non-waste technologies emerged, and the emphasis shifted to pollution prevention rather than pollution treatment. (El-Kholy, 2002; Bhandari, 2018; Matsenko, 2011). After that, according to the 1st European Roundtable on Cleaner Production Programmes, 1994 CP was specified as the conceptual and procedural approach to production that demands that all phases of the life cycle of a product or of a process should be addressed with the objective of prevention or the minimisation of short and long-term risks to humans and the environment. A total societal commitment is required for effecting this comprehensive approach achieving the goal of a sustainable society.

The (Fresner, 1998; Hájek, 2019) identified CP as a preventive strategy to minimize the impact of production and products on the environment. The principal actors are the companies, which control the production processes. They are influenced strongly by their customers and politics. From the another point of view (Yaacoob and Fresner, 2006; Abrahám, 2018) CP is a preventive, company-specific environmental protection initiative. It is intended to minimize waste and emissions and maximize product output.

Glavic and Lukman (2007) describe CP as a systematically organized approach to production activities, which has positive effects on the environment. These activities encompass resource use minimization, improved eco-efficiency and source reduction, in order to improve the environmental protection and to reduce risks to living organisms. It can be applied to processes used in any industrial sector and to products themselves (cleaner products) (Bappayo, 2018; Mura, 2018b). Hari Srinivas (2015) proposes to define CP with the accounting the business activity features: CP is a preventative approach to managing the environmental impacts of business processes and products. CP uses changes in technology,

processes, resources or practices to reduce waste, environmental and health risks; minimize environmental damage; use energy and resources more efficiently; increase business profitability and competitiveness; and increase the efficiency.

This the technical vision on cleaner production at the local, company level scale illustrated by Khalili, (2015): “Cleaner Production (CP) strategies are fundamentally concerned with operations, environmental sustainability and maximization of waste reduction, recycling, and reuse at the enterprise level, and are thus microeconomic in scope”.

The scientists from the Kaunas University of Technology Lithuania (2017) characterize CP as a preventive, integrated continuous strategy applied to products, processes, and services, to enhance efficiency, which improves environmental performance and reduces costs. The definition of European Commission (Review of cleaner production, 2017) defines cleaner technologies as technologies that extract and use natural resources as efficiently as possible in all stages of their lives; that generate products with reduced or no potentially harmful components; that minimize releases to air, water and soil during fabrication and use of the product; and that produce durable products which can be recovered or recycled as far as possible; output is achieved with as little energy input as is possible. Generalizing the main approaches to understanding the cleaner production gives the opportunity to emphasize the key elements: housekeeping, process optimization, raw material substitution, new product design, new technology.

It should be underlined that targets of CP also are in the process of evolving. According to L. Hens (L. Hens at al., 2018) the focus is on three aspects:

1. While originally the approach was mainly applied contributing to sustainable development in the production sector, involving the service and administrative sectors, next to the decision makers points to its relevance for a broader societal realization of sustainable development. Monitoring and assessment instruments should be adapted to this new and evolving context.

2. This widening towards sustainable development has far going consequences. The main one is the dilution of the environmental targets. More and more environmental quality and responsible use of resources is not anymore, a target by itself. As an element of sustainable development, it becomes embedded in a wider strategy addressing also economics and social aspects. At the policy level quality of life targets, of which environment is part, move on the forefront.

3. The widening of the targets also manifests itself at a strategy level. Originally, business and industry had to cope with the effects of major calamities. They reply was first negating the issue by moving the attention towards other aspect as jobs. Following acceptance of their undercooled attention for environmental issues, they installed environmental (including energy and resources) management. This illustrates the defensive the strategy during the first post Second World War decades. Embracing environmental management fundamentally changed this strategy: It allowed industry acting in a proactive way on environmental challenges. The approach allowed going beyond legal compliance and performing better on energy consumption and pollution than prescribed by the permits. This provided the sector a much more reliable perception in the environmental and sustainability debate. This fundamental move might provide a guideline for other sectors. Agriculture, forestry and fisheries e.g. should leave their environmental impacting perception behind and opt for sustainable food production methods.

For promoting better understanding of cleaner production among companies the nine guiding principles were formulated. So, the principles adopted by Veleva and Ellenbecker (2001) from the Lowell Center for Sustainable Production include the next main points (figure 1).

Implementation of Cleaner Production principles will be effective in the case when a company have strong habits of core practices and principles. According to Prindle W. R. (2010) the best corporate strategies for introduction cleaner production described in figure 2.

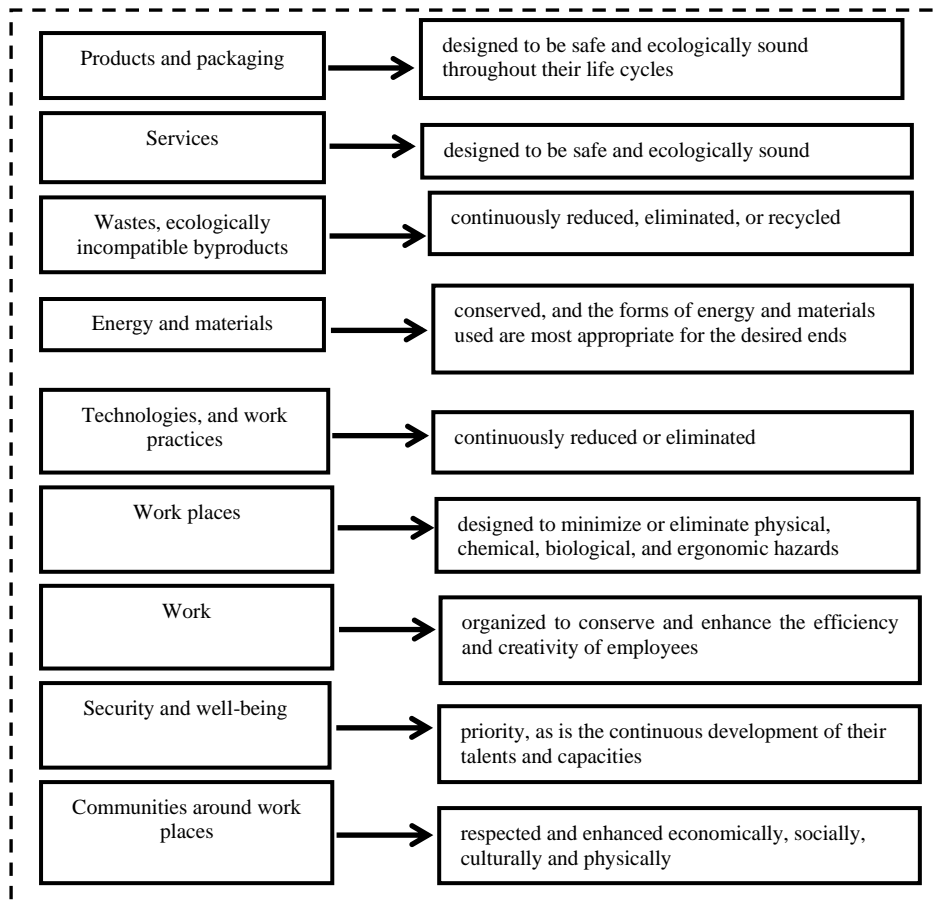


Figure 1 - Cleaner production principles

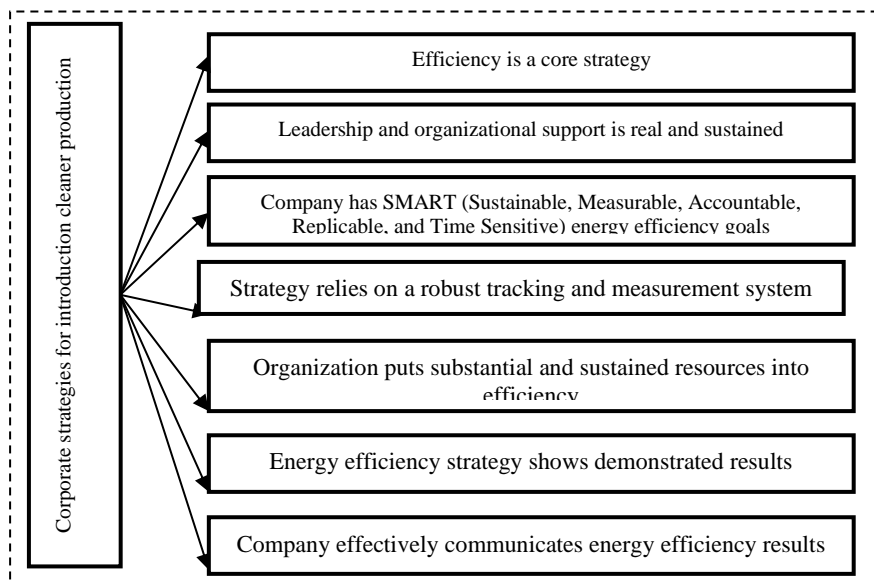


Figure 2 - Corporate strategies for introduction cleaner production

It should be noted that sustainable practice in generalising and systematisation processes in cleaner production does not exist. The examples of cleaner production could include:

- reduction in the quantity of material or energy consumed in manufacturing a unit of product;
- certain forging techniques reduce the amount of material required to make the product while also reducing machining energy and waste;
- reduction in the hazardous material required to extract a unit of mineral in metallurgical processes;
- pre-aeration of ore in water increases efficiency of gold extraction, thereby reducing the use of cyanide;
- reduction of materials used in a product Lightweight bottles and small caps for water bottles;
- reduction of air emissions, wastewater, and solid waste generated in production of a unit or product;
- resource efficiency as pollution prevention, as in the case of recycling water to achieve zero discharge;
- reduction of water and energy use in hospitality services;
- water-efficient showers and toilet appliances; lowenergy illumination;
- reduction of energy use in low-income housing by using green building design;
- energy-efficient orientation to maximize the amount of light entering housing units.

Implementation of the cleaner production practices need wide understanding of the necessity of their development and providing across the society (figure 3).

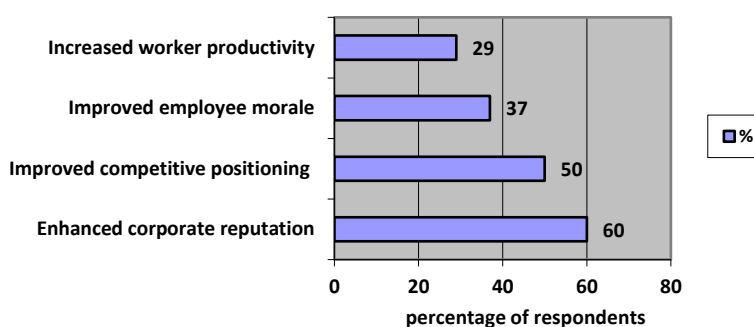


Figure 3 - Co-benefits of cleaner production investments

In the beginning of the XXI century the world practice in implementation the cleaner production practices show the next tendencies (Dieleman H. and Cramer J., 2004; Falkowski, 2018) (figure 4).

According to L. Hens deepening and the widening the concept of clean production could be provided in different modern ways: green economy; circular economy; corporate social responsibility; smart cities etc. (L.Hens, 2017; Lyulyov, 2018; Vojtech, 2019).

The important question in the theory of cleaner production is the approaches how to evaluate and measure the level of implementation and spreading. Many reasons may be hold accountable for the rate of implementation of cleaner production. Some explanations used in the evaluation studies are “a lack of capabilities“, “a lack of resources“, “a lack of management commitment“, and “a lack of an appropriate institutional framework“. Some reasons focus on processes inside companies, others on the institutional environment around companies. Each of them can be looked at as reasonable explanations for the rate of implementation that is lower than initially expected. (Dieleman H. and Cramer J., 2004; Mura, 2018a; Peterková, 2018).

Cleaner Production assessment is one of the specific Cleaner Production diagnostic tools. This is a systematic procedure for the identification and evaluation of Cleaner Production

options for the companies that are launching a Cleaner Production project. The methodology allows us to identify areas of inefficient use of resources and poor management of wastes in production (United Nations, 2012). The aim of the assessment phase is to collect data and evaluate the environmental performance and production efficiency of the company. Data collected about management activities can be used to monitor and control overall process efficiency, set targets and calculate monthly or yearly indicators. Data collected about operational activities can be used to evaluate the performance of a specific process.

Evaluation studies in the field of cleaner production	
<p>Europe</p> <p>Most companies didn't implement any CP options between 1990-1995</p> <p>In various project 40% of the options generated are implemented</p> <p>About 40 % of the options are implemented in Graz' Eco-Profit Project (Austria)</p> <p>Evaluation PRISMA: less than 50% options realized after 5 years</p> <p>Many evaluation show that Industries lack capabilities for implementation</p>	<p>USA</p> <p>Evaluation of 15 year Cleaner production in the USA:</p> <ul style="list-style-type: none"> - in large industries a shift towards CP is noticeable - medium sized industries are interested and many options are identified - in small industries, the process is 'tentative' <p>70% of the companies have no resources for implementation</p> <p>40% of the companies have too high rate of staff changes and have a lack of management commitment</p>

Figure 4 - Cleaner production studies

Indicators of cleaner production address all three dimensions of sustainable development - environmental, social and economic. The indicators of cleaner production are developed mainly for production facilities, and they aim to address all key aspects of production - energy and material use (resources), natural environment, community development and social justice, economic performance, workers, and products (Lyulyov, 2017b).

The indicators of cleaner production have the following main objectives: educate business about cleaner production; inform decision-making by providing a concise information about the current state and trends in a company/facility performance, environmental programs; promote organizational learning; provide organizations with a tool to measure their achievements toward cleaner production goals and targets; allow for comparisons between organizations' performance in the environmental, social, occupational and economic aspects of their production; provide a tool for "cross-checking" organization's mission and reporting results to interested stakeholders; provide a tool for encouraging stakeholder involvement in decision-making (V. Veleva, 2001)

On the base of the White, A. and Zinkl, D. (1999) were suggested twenty-two core indicators. They were chosen to measure common issues for all production facilities, such as chemical releases, energy use, water use, hazardous and non-hazardous waste, work-related accidents and injuries, charitable contributions.

The system of proposed indicators includes the next indicators: freshwater consumption, materials used; energy use; percent energy from renewable sources; kilograms of waste generated before recycling; global warming potential, acidification potential; kilograms of persistent, bioaccumulative and toxic chemicals used; costs associated with environment, health and safety (EHS) compliance; rate of customer complaints returns; organization's openness to stakeholders involvement in decision-making process; community spending and charitable contributions as percent of revenues; number of employees per unit of product; number of community-company partnerships; lost workday injuries and illness case rate; rate of employees' suggested improvements in quality; social and EHS performance; turnover rate; average number of hours of employee training; percent of workers who report complete

job satisfaction; percent of products designed for disassembly, reuse or recycling; percent of biodegradable packaging, percent of products with take back policies in place.

Promotion of cleaner production is an essential part of the work needed in a country to introduce CP strategies. Industrialists are most often skeptical to cleaner production methods to start with.

Cleaner production promotion has to cover a range of related activities. Most important among these are:

- awareness raising campaigns targeting industry, government, financing institutions, academia, and NGOs;
- compilation and dissemination of up-to-date information on cleaner production practices and technologies in a user-friendly manner, addressing specific local (regional, national) needs;
- human resources development of personnel at various levels in the stakeholder groups;
- demonstration projects in different sub-sectors and locations in the country especially in SMEs.

Since CP is a cross-cutting, multi-sectorial issue a collaborative approach should be applied at all hierarchical levels (state, municipalities, etc.) to integrate preventive environmental strategies and efficient resource management in public policies (table 1).

Building infrastructure in industry, government, NGOs, academia and other cleaner production supporting institutions is essential for achieving advances in both the development and promotion of cleaner production. This capacity building for cleaner production should address the following needs:

- a common understanding of the cleaner production concept.
- integration of the cleaner production concept in policies and operations of all enterprises.
- education and training at all levels.
- development of indicators to measure progress in cleaner production implementation.
- incorporation of the cleaner production concept in the government policy framework.
- providing information about both the technology involved and the environmental management tools needed.
- integration of the environmental dimension in education (in schools, universities, and engineering and business management courses).
- assisting key institutions in the development/delivery of the above.

Generalizing scientific background about perspectives and challenges of cleaner production developing give the opportunity to formulate the main barriers of cleaner production implementation. In the last years, cleaner production has led to a paradigm shift in environmental management at the level of stakeholders, industries, businesses and financial institutions, as well as local governments and communities. However, there have been a number of barriers to the promotion and adoption of cleaner production.

According to (Getting, 2015; Okuneviciute Neverauskiene, 2018) barriers arise from a combination of the following factors, any of which can impede the uptake of CP:

- companies' lack of focus on CP;
- lack of awareness of cost savings from CP and hence reluctance to invest upfront costs;
- lack of technical ability to identify CP projects and develop these into profitable projects;
- perception of risk of implementing a technology that may be outside the industry norm;
- lack of access to finance, although many CP investments require relatively modest sums.

Table 1 - Networks and Partnerships for cleaner production promotion

Example	How to use
Sustainability Web Ring - service of the sustainable development communications network	Internet tool allows users to navigate easily between web sites promoting cleaner production that deal with the principles, policies, and best practices for sustainable development
EnviroLink - site with extensive listings and many support services for NGOs	It maintains the sustainable business network, which is a good resource for finding potential partners on projects
The Regional Environmental Centre – for Central and Eastern Europe	Has links to many NGOs in that region as well as Western Europe
Law and Environment Eurasia Partnership - grassroots non-profit organisation, formed by NGOs in Central Asia	To improve existing environmental legislation, policies, and enforcement in Central Asia, develop conservation projects, provide information to local NGOs, and encourage Western support for civil society in Central Asia
Environmental Defence – US-based national non-profit organisation engaged in many partnerships with different industry groups and communities	To create innovative, equitable and cost-efficient solutions to environmental problems

The scientists from the UNDP (UNDP, 2012) systematized a number of barriers to the promotion and adoption of cleaner production.

1. Resistance to change. Many stakeholders have an attitude to follow business as usual and not adapt to change. Any change is considered as unwarranted, risky and not necessarily profitable.

2. Lack of information, expertise and adequate training. Many a time, the stakeholders are interested in the concept of cleaner production but are unable to put it in practice, due to information gaps and lack of technical assistance.

3. Lack of communication within enterprises. At times, a stakeholder gets interested in cleaner production and has the necessary skills or expertise. However, the stakeholder is unable to communicate the concept and its benefits to the top management. This creates a barrier to implement cleaner production.

4. Competing business priorities - in particular, the pressure for short-term profits.

A significant impediment to the adoption of cleaner production is the emphasis of enterprises on short-term profitability. Since enterprises are judged by markets and investors principally on short-term performance, they have difficulties in justifying some of the investment in cleaner production processes and technologies, even when there are demonstrably attractive long-term financial returns.

5. Perception of risk Cleaner production involves possibilities of process modification, equipment replacement or product/packaging redesign. Some stakeholders view this as risky, especially if the technology is not proven, or the product is not tested in the market.

6. Difficulty in accessing cleaner technology. Investment in new, cleaner technology is a major decision for enterprises to undertake. In addition to the substantial costs of new technology, there are several potential external barriers, which may discourage or prevent enterprises from updating their existing plant and equipment. These can include the complexity of new technology, the level of technological specificity (cleaner technologies may be hard to transfer from one user to the other), etc.

7. Accounting systems which fail to capture environmental costs and benefits. Accounting systems and project appraisal procedures very often fail to take adequate account of environmental impacts, risks, liabilities and associated costs (which are not easily quantifiable to start with). Because of these limitations, the stakeholder is often unable to place environmental performance in the business perspective and therefore fails to fully appreciate the economic benefits of practicing cleaner production.

8. Difficulty in accessing external finance. The implementation of cleaner production technologies has been hindered by a lack of access to finance. Banks, government investment agencies, corporate financial departments, venture capitalists, and other sources of risk capital for industry either discriminate against or do not have the competence to evaluate applications that concern cleaner production programmes, thus severely limiting their access to capital.

9. The failure of existing regulatory approaches. A lack of orientation in the existing national policy and regulatory framework towards cleaner production is one of the major impediments to the adoption of the cleaner production strategy. Conventional regulatory approaches have in many cases proved to be counterproductive to the uptake of cleaner production. By assuming that the regulators are in the best position to determine appropriate action, regulations may engender an attitude of complacency on the part of the management.

10. Perverse economic incentives. Economic subsidies for business resource inputs may be a significant disincentive to cleaner production. For example, to the extent that governments subsidize the price of energy and water or the prices of relatively polluting fuels, through subsidies, they will diminish the financial benefits of cleaner production.

CONCLUSION

So, creating the economical and institutional preconditions for developing and promotion the cleaner production have to minimize the resource using as well as optimize the reusing and recycling of materials. The approaches and technologies should create the preconditions for using resources in the manufacturing process in a more efficient way, reduce the amount of inputs needed and the amount of non-desired outputs. It can also seek to minimize the risk to and improve human capital through improvement of working conditions and safety programs. Although such technologies usually require capital investment, it often gives monetary returns by minimizing energy consumption and lowering material and handling costs. By doing this, the cleaner production approach becomes both an environmental and a production strategy.

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АНОТАЦІЯ

О. Чигрин, Н. Артюхова, Т. Василина. Чисте виробництво як драйвер зеленої конкурентоспроможності

У сучасних умовах екологічно чисте виробництво є необхідною складовою для досягнення сталого розвитку. Просування зеленої конкурентоспроможності компанії неможливе без впровадження зелених технологій та чистого виробництва. Метою статті є узагальнення основних підходів до розуміння чистого виробництва з визначенням його ключових елементів. Автор визначили головні цілі чистого виробництва. Просування чистого виробництва серед компаній повинно базуватися керівних принципах його реалізації. Основні сфери, в яких повинні працювати принципи: продукція та упаковка, послуги, відходи, екологічно несумісні побічні продукти, енергія та матеріали, технології та практика праці, робочі місця, безпека та добробут громади, організація робочих місць. Вони пов'язані з усіма стадіями виробничо-комерційного процесу. У роботі визначено корпоративні стратегії успішного впровадження чистого виробництва. Ключовими елементами стратегії є ефективність та впровадження технологій відновлюваної енергії. У роботі автор узагальнили основні сфери реалізації чистого виробництва. Автор підкреслює, що впровадження практик більш чистого виробництва потребує широкого розуміння необхідності їх розвитку та забезпечення у всьому суспільстві. Таким чином, спільними перевагами його просування є підвищення продуктивності праці, встановлення моральної та екологічної етики роботодавців, покращення конкурентного позиціонування, покращення зеленого корпоративного іміджу та репутації компанії. Автор наголошує, що просування чистого виробництва повинно включати заходи, пов'язані з підвищенням екологічної обізнаності зацікавлених сторін, складання та розповсюдження актуальної інформації про практики зеленого виробництва та екологічні технології; розвиток людських ресурсів; надання демонстраційних проектів у різних підгалузях та місцях в країні. Узагальнення наукового доробку про перспективи та проблеми впровадження чистого виробництва дає можливість сформулювати основні бар'єри його розвитку.

Ключові слова: забруднення, чисте виробництво, сталий розвиток, економічний розвиток, вплив на навколишнє середовище, стратегії, переваги.