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Environmental problems, risks and challenges of contemporary production

In this article we would like to discuss whether economics and ecology, two seemingly conflicting "eco" sciences confront or reinforce each other? First, we will try to define major environmental problems, solutions and risks. Major issues in environmental risk management – methodologies are employed by modern companies to enhance their business and make optimized decisions (environmental disasters, eco-efficiency, environmental impact of technologies and products); green advertising (past, now, future); energy production and consumption issues (optimizing energy production and energy efficiency).

Key words: green economy, eco-efficiency, energy efficiency, risks, green advertising.

Economics vs. ecology

It is widely known that the Greek word 'oikos' is the common root for the 'eco' in both terms "economics" and "ecology". It is sometimes stated that ecology is the science of nature's housekeeping, while economics is the science of human housekeeping. That is why the contemporary tension between ecology and economics is looking strange.

We have at least two possibly conflicting objectives in our decision making and those are minimizing environmental impact and maximizing economic profits. While during the 20th century economic and ecological goals were mostly conflicting with each other, nowadays those goals are getting more and more aligned. The target of reaching sustainable development assumes that meeting the needs of the future depends on how well we balance economic and environmental objectives or needs when making decisions.

Nowadays, greening of economy presents more opportunities, but at the same time we are facing many more environmental risks. From one side, companies go green and number of green goods constantly grows. Currently many companies are taking advantage of the green "rush" by producing green products. Companies also try to "green" their production processes. This way they can achieve a competitive advantage by implementing an environmental policy and producing green products. It is one of the major drivers for the companies.

Next, we would like to discuss an environmental impact. We start with environmental impact of different energy sources and environmental impact of different products manufactured by companies. Energy can be produced from different energy sources, e.g. from coal, natural gas, and biomass. In addition, wind energy and solar energy can be also used. Results of energy production can have different environmental impacts. In some cases we have greenhouse gas emissions, for instance, if we burn coal. Moreover, there are different wastes: chemical waste, solid waste, water discharge, etc.

New technological advances, especially in the renewable energy sector, reduce the amount

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of greenhouse gas emissions. On the other side, we face more environmental risks that are resulted from both human activity and natural disasters. As a result of human activity many natural disasters, like earthquakes, lead to environmental catastrophes that include soil and water contamination. Consequently, environmental risks need to be evaluated more carefully than in the past. For instance, building new infrastructure such as nuclear power stations without complex investigation of all environmental risk factors is too dangerous and can lead to large losses, both in human lives and in economic downturns.

Currently, businesses are taking the lead in building an environmentally sustainable future and governments are only providing support for those initiatives. It is completely different from the situation in the past decades, when governments were imposing environmental regulations on industries. Transformation of the business environment towards producing green products and implementing projects is impossible without support of customers who are willing to pay (and pay higher price in many cases) for green products and technologies in order to minimize their environmental footprint. Education plays an important role here and sometimes the environmental education takes such unusual channels as TV advertisements and computer games that indirectly teach people how to be environmentally responsible.

Many companies increase their publicity and environmental awareness by publicizing their environmental initiatives like greenhouse gas emissions reduction resulted from clean technologies or from minimizing processing times and customer waiting times. The competition has increased as companies and businesses can make profits by going green. The fastest growing "green" industrial sectors are the renewable energy and innovative technologies for operating buildings. Renewable energy sources are solar panels and wind mills. Innovative technologies for operating buildings include "green" housing as well as geothermal heating and cooling. These two directions created the concept of distributed power generation that will replace centralized power generation at the power stations by power generated at the residential buildings and re-distributed among the consumers. Those new power grids can be highly optimized using smart computing in order to improve effectiveness of energy distribution even more.

The third group of environmental impacts is the impact on biodiversity and land use. Wind energy sources can still produce pollution in some cases, e.g., influencing migration routes and generating much noise. We can compare these energy sources and environmental impacts that they produce. In some cases green technologies are not that green, due to pollution produced by those energy sources. Even green technologies (wind energy and solar energy generation) still produce pollution and environmental impact. Moreover, environmental impact of green products is getting more and more widespread.

Contemporary tension between ecology and economics can be described by a number of challenges: How do we build an economic system that takes into account what nature does for us now? Should we put a price/value on economic externalities (growing forests, soil preventing erosion, etc. all those services that nature performs for us)? How do we build an economic system that is in a steady-state? Currently, our economic system operates with the assumption that it can grow forever. It is not serving our needs, but serving our wants.

We are facing with a massive problem in planning for the sustainable future. The old-fashion primary objective of every business, i.e., maximizing profit, is becoming obsolete. There are two (possibly) conflicting objectives in our decision making: maximizing expected profit and minimizing environmental impact subject to operating constraints. This can be done through minimization of fossil fuel use, maximization of carbon sequestration, and optimization of energy use. Energy efficiency gets priority in industry, transportation and

construction: On the consumer end optimising the use of this energy will be vital, construction minimizing traffic, smart timing of appliances or tons of other things. Green energy solutions involve efficient combination of many disparate heterogeneous power sources like wind turbines in different locations, small hydro, micro hydro, solar and conventional.

Risk management

Contemporary production faces risk management challenges. Mathematical modeling and business analytics techniques are required to tackle these challenges. Environmental risk management includes:

– reducing risk of accidental pollutions, etc.;

– assessing, mitigating, and monitoring certain risks involved with daily operations of companies;

– identifying risks for the local and global environment .

Accidents, natural events, and deliberate actions are possible sources of caused pollution. In order to limit and, hopefully prevent these situations environmental risk management strongly emphasises implementing a system that helps with prevention

Risk management procedures have a number of steps. Usually it starts with identifying influential factors - political, economic, legal and social. Next, there is a process of problem formulating. At this stage researchers try to answer the question: "What are we trying to assess and why?" For instance, for hazards identification we need to answer the question "What hazards exist?" There is also a need for pollution assessment. How likely does pollution occur and how much air, soil, water will be polluted? Usually exposure assessment is done first, after that consequence analysis or dose – response analysis is done. All these steps lead to risk estimation – a quantitative or qualitative measure of risk. Such risk assessment is necessary for achieving eco-efficiency.

Eco-efficiency

The term eco-efficiency was coined by the World Business Council for Sustainable Development (WBCSD) in its 1992 publication "Changing Course". It is based on the concept of creating more goods and services while using fewer resources.

Strategies that have been linked to eco-efficiency include "Factor 4" and "Factor 10", which call for specific reductions in resource use, "natural capitalism", which incorporates eco-efficiency as part of a broader strategy, and the "cradle-to-cradle" movement, which claims to go beyond eco-efficiency in abolishing the very idea of waste. According to Boulanger (Boulanger, 2010), all versions of eco-efficiency share four key characteristics:

– Confidence in technological innovation as the main solution to unsustainability.

– Reliance on business as the principal actor of transformation. The emphasis is on firms designing new products, shifting to new production processes, and investing in R&D, etc., more than on the retailer or the consumer, let alone the citizen.

– Trust in markets (if they are functioning well).

– "Growthphilia": there is nothing wrong with growth as such. Moreover, with "cradle-to-cradle", growth is conducive to sustainability per se.

To be sustainable organizations must embrace new objectives: optimize operations to minimize environmental impact (Fig. 1) and improve social outcomes in a manner that also maximizes performance.

No matter what your business is, sustainability is your business. For example, by 2025 buildings will use more energy than any other category of "consumers" (today, in the United States they represent 72% of energy use). In addition, 40% of the world's current output of raw

materials goes into buildings. That is about 3 billion tons annually.

Benefits of eco-efficiency refer to increase in economic value with unchanged (or decreased) environmental impact. As indicated in Table 1, four variants of increased eco-efficiency indicators (environmental versus economic result) can be defined.

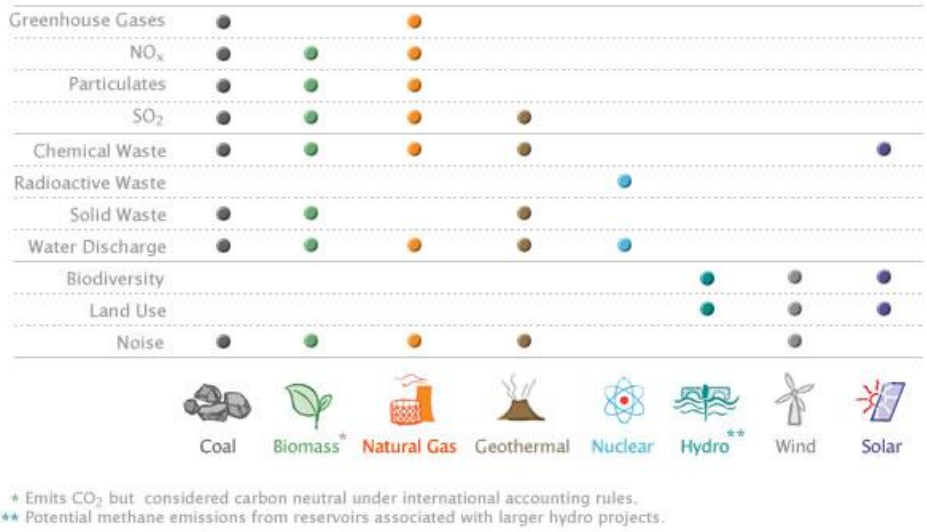

Figure 1. Environmental impact (Environmental, 2012)

– *An increase in eco-productivity,* i.e., efficiency of environmental impact;

– *A decrease of nature intensity,* i.e. a decrease of costs of natural factors;

– *An increase in the efficiency of environmental costs,* i.e. better state of the environment per unit of environmental cost;

– *A decrease in environmental specific costs* i.e. costs per unit of environmental state improvement.

– Increase in efficiency is one of the key success components in business. Enterprises constantly seek ways to improve their efficiency.

– Figure 4 summarises the main instruments which are effectively used in the framework of modern environmental and economic policy to increase the eco-efficiency (Ekins, 2005).

Eco-efficiency (EE) refers to the idea to produce more goods and services using less resources. EE is defined as:

$$EE = P_e / B_n, \quad (1)$$

where P_e is the economic result (the additional value of produced net goods, additional profit etc.); B_n - an estimation of the environmental impact (in particular, the amount of consumed natural goods and their monetary value, economic environmental damage).

The basis for evaluating eco-efficiency is the integral material intensity indicator (M_u)

$$M_u = \sum M_i / \sum S_i, \quad (2)$$

where $\sum M_i$ is the input of material costs (natural raw materials) in the production process or production chain; and $\sum S_i$ is the quantity of services provided (produced goods). The inverse ratio $\sum S_i / \sum M_i$ is the conditional equation for *natural-resource efficiency* or *eco-efficiency.*

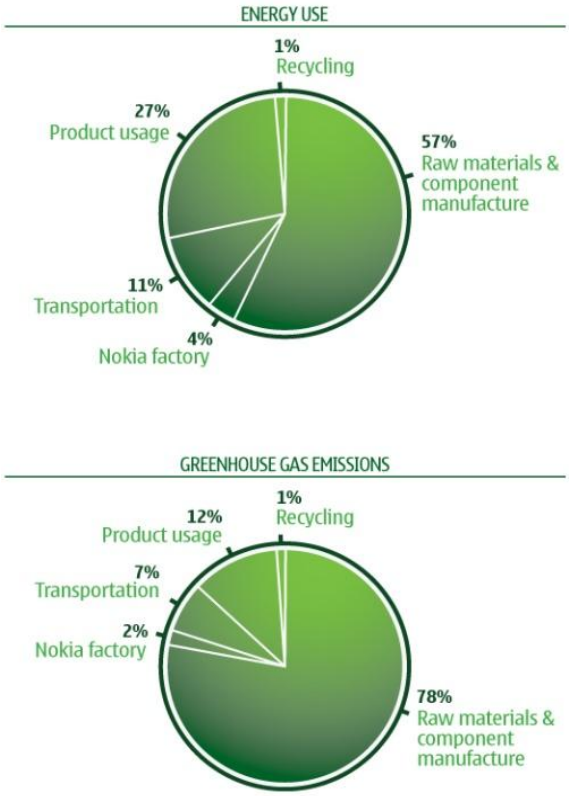

Figure 2. Energy use and greenhouse gases emissions (Environmental, 2012)

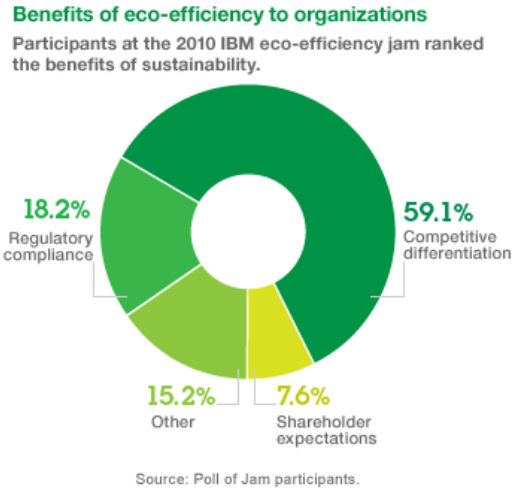

Figure 3. Benefits of eco-efficiency to organizations (Environmental, 2012)

Table 1 – Four types of eco-efficiency

Ratio	Goal	
	Productivity increase	Environmental state improvement
Economic versus environmental indicators	Total production per unit of aggregate environmental impact costs or *environmental productivity*	Sum of costs incurred per unit of environmental state improvement indicator (averted damage)or costs of environmental state improvement
Environmental versus economic indicators	Environmental impact indicators (ecological-economic damage) per unit of production or *environmental intensity*	Improvement of environmental state per unit of costs or *environmental cost-effectiveness*

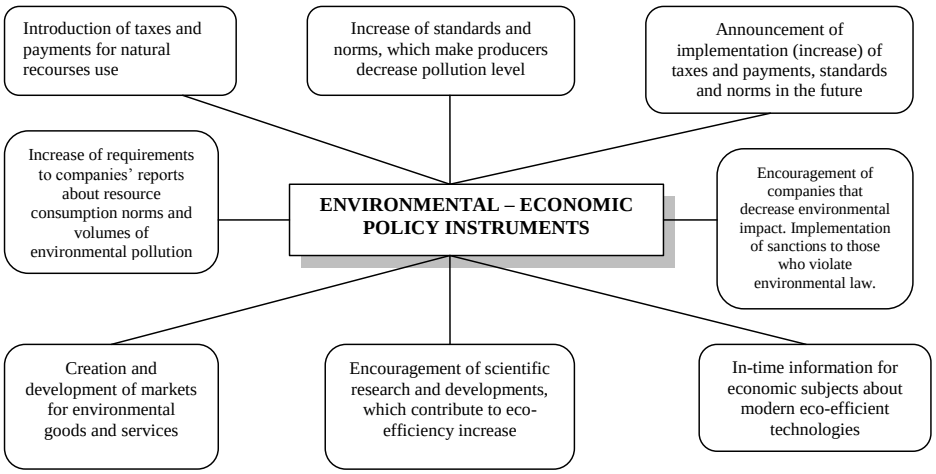

Figure 4. Instruments for Environmental – Economic Policy

The integral material intensity analysis (or M_u – analysis) allows identifying more effectiveness of goods; in other words *dematerialization* of the economy. This allows addressing environmentally dangerous *outputs* (emissions, discharges, wastes etc. at the end of production process or consumption) in relation to the flow *inputs*.

Green advertising

Many companies start paying attention to environmental impact of their production. Companies are using green advertising more and more widely. Green advertising is a specific type of advertising that is centered around promoting factors having to do with the environment. Often companies that use green advertising also use environmentally-friendly operations and product packaging.

Green advertising is also used to attract attention to environmental problems and raise awareness about environmental problems. Companies start to advertise their green products.

They claim that their product is green, so consumer should buy their products.

Today green advertising appears in both the traditional media, i.e., broadcast and print and the new media (web sites, streaming audio and video, e-mail, DVDs and CD-ROMs).

Many companies advertise their products and their green technologies, e.g., Toyota's slogan "Harmony between man, nature and machine".

Conclusions

Two "eco" sciences, Economics and Ecology, can both conflict and reinforce each other. Environmental risk management reveals higher risks of both economic and environmental disasters and companies try to use new technologies and products with low environmental impact. Green advertising becomes more effective and persuasive. Energy production and consumption need to be optimized. In conclusion, innovation, technological advances and modern information technology including optimization will be the leading forces driving sustainable development and rational use of natural resources. Higher environmental risks that we are facing will need to be taken into account when planning for the new and managing existing industrial infrastructure.

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Екологічні проблеми, ризики і виклики сучасного виробництва

У статті аналізуються екологічні проблеми сучасного виробництва, а також основні проблеми у сфері управління екологічними ризиками, оптимізації виробництва енергії та енергоефективності.

Ключові слова: «зелена» економіка, екоефективність, енергоефективність, ризики, «зелена» реклама.

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Экологические проблемы, риски и вызовы современного производства

В статье анализируются экологические проблемы современного производства, а также основные проблемы в сфере управления экологическими рисками, оптимизации производства энергии и энергоэффективности.

Ключевые слова: «зеленая» экономика, экоэффективность, энергоэффективность, риски, «зеленая» реклама.