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NEED TO LINK THE TWO CRUCIAL CONTEMPORARY STRATEGIES – SUSTAINABLE DEVELOPMENT AND INNOVATIVE ECONOMY

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Abstract. The economic development has been so far dependent on the utilization of natural resources – of areas and materials – which proceeds with much higher rates than the ecosystems could restore their inherent potential. The paper deals with the "ecosystem services" evaluation and innovative economic realization as a significant step guaranteeing the future sustainable development. The eight methods for the assessment of ecosystem goods and services and the six steps for the realization in the innovative economy are simultaneously analyzed. The national wealth, the structure of natural capital and the degree of innovativeness of the economy in Bulgaria and in 12 selected countries are comparatively scrutinized. The importance of the assessment of natural capital and ecosystem services for the sustainable development and the necessary compatibility of innovative economy with ecology as well as its possible role for the maintenance of natural capital are discussed. The concept for the "ecosystem services assessment" and "ecologically compatible innovative economy" as two of the sides of the overall strategy of sustainable development are proposed. The concept alone can ensure the implementation of the "paradox" for simultaneously economic development and environmental protection.

Keywords: sustainable development, innovative economy, green economy, yellow economy, ecosystem services, ecological biotechnology

Introduction

According to WCED (1987) the Agrarian and Industrial Revolution in the past were driven by new discoveries or the progress of technologies, while ecological revolution – facilitated by the technologies – will be driven by our need to make peace over with nature. These ideas lead to the emergence of the concept of "sustainable development". Sustainable development combines two main trends in society: (1) achieving sufficient economic development to provide an increased standard of living and (2) protecting and improving the environment for the future. Accomplishment of the first is possible only through the transformation of the existing economy in "innovative", but ecologically compatible with "green" and "yellow" economy (Pauli, 2010). The innovative green

economy can provide rising the living standard while using less natural resources and money for their regeneration, i.e. such business behavior, which (among other things) leads to reduction of pressure on environment. Difference should be made between developing and innovative economy. It is argued that growth is good for biodiversity – there is an environmental Kuznets curve illustrating that environmental conditions get worse in the early phases of developing the economy, but improve once it turns into developed one. It is argued that at this level it correlates with more resources to invest in conservation the biodiversity and reducing the use on bio-resources. But there is one unpleasant fact. As a country's GDP increases, so does its overall ecological footprint—its consumption of food, water, materials and energy – and increased consumption is driving the current biodiversity crisis. But the majority of the negative impact has simply been exported. The industries that produce the most pollutants have been outsourced to emerging nations that have fewer regulations, in terms of both the environment and labor conditions. Therefore the environmental impact of increased consumption is largely felt by the middle- and lower-income nations that consume the majority of environmental degradation and biodiversity loss. The currently accomplished growth has very negative impact upon biodiversity. What needs to change is to raise the innovations in the growth of a GDP to a level that ensures the raw materials needed for economy and their polluting parts by new kind of economy. For the realization of the second – the services of nature for the development of various sectors of the economy, need to be assessed, i.e. their conversion into products with the corresponding market value. This will enable the use of "earned money" from nature for reproduction of already spent resources. This would ensure the sustainable existence of two mutually confronting processes – economic development and the preservation and development of the environment. The high standard of living should not be at the expense of environmental degradation. In other words, the two concepts "innovative economy" and "assessment of ecosystem services" are closely related in our ambition for "reconciliation with nature" and the sustainable existence of the biosphere. The conventional formulation and typology of ecosystem services in the world is done by more than 2000 authors in the framework of "The United Nations Environment" in the period 2001-2005 and is known as the "Millennium Ecosystem Assessment" (MEA, 2005).

Within the framework of this document four categories of ecosystem services are identified, which are the theoretical foundation for the assessment of ecosystem services. The typology of the ecosystem services is in conformity with the typology of the millennium ecosystem assessment (MEA, 2005). There is also a shorter definition of ecosystem services, "the conditions and processes through which natural ecosystems support and provide human life" (Daily, 1997). The material (provisioning) services cover products derived from the nature: e.g. forest products – 1% of global GDP and

3% of international trade, agricultural production – 10% of gross domestic product (GDP) in developed countries and 50% of the GDP of developing countries (Costanza et al., 1997). Regulating services comprise all ecosystem and biosphere's processes, providing self-regulation and homeostasis of macro-bio-systems as biogeochemical cycles, biological cycle and others processes, regulating the quality of the environment and the health status of the biota. The cultural services are intangible benefits for humans as aesthetic pleasure, intellectual and spiritual inspiration, a sense of belonging to a particular natural site, a pleasure from the existence of the ecosystem and its use for various forms of ecotourism. Supporting services create the conditions for the qualitative effect of the other three groups of services. Supportive services include: soil formation on which most tangible services depend; the photosynthesis, providing oxygen, primary production; nutrient cycling and water cycle.

The expression of conscious importance of biodiversity for ecosystem functioning and maintenance of ecosystem services has created an international platform IPBES[1)] in 2013 with adopted Program for 2014 – 2018.

As the future economic development should be closely linked to the protection of environment as one of the elements of the concept of sustainable development, future co-assimilation of two concepts – "ecosystem services" and "economy" through the means of the "innovative economy" is necessary, which is the goal of the present study.

Methods

Ecosystem goods and services are economic commodities that have value, but most of them (excluding materials) are not in circulation in the market and it is very difficult to determine their price. This difficulty could be overcome through the introduction of the term "Integral economic value" or the "Total economic value", which concerns the complete contribution to the welfare of people. The integral economic value composes the values of use (direct, indirect and potential) and values that are associated with the use of natural resources and the desire to conserve natural resources for future generations or the satisfaction of people. *Value of a direct use* (i) – corresponds to the material services or the products extracted from nature. *Value of an indirect use* (ii) – considers the regulatory services or the maintenance of the circulation of the substances, the river stream, the climate, the pollination, etc. *Value of the possible use* (iii) – concerns the use of products and services that cannot be used at the moment, including material, regulating and cultural services, but can be used in the future. *Non-use value* (iv) – includes the desire of human being to protect plant and animal species, along with the ecosystems and landscapes without receiving direct benefits. Very often Non-use value is evaluated through surveys of people's attitudes towards environmental issues (Pagiola et al., 2004).

The known methods of evaluation of ecosystem goods and services are: the method of the market prices; the method of the productivity; the method of the hedonistic market; the method of the shipping costs; the method of the price of the avoided damages, expenditures for replacement or substitute; the method of the conditional valuation; the modeling of the choice method and the transfer method.[2)] Some of these methods are used in Bulgaria as the *transfer method*, the *conditional method* and *method of transport costs*. The transfer method is used in the project "Rodopi", 2005, and for the valuation of ecosystem services in the basin of the Malki Iskar River. Modeling the choice method is often perceived as a variant of the conditional method, and its application is related to determining of focus groups.

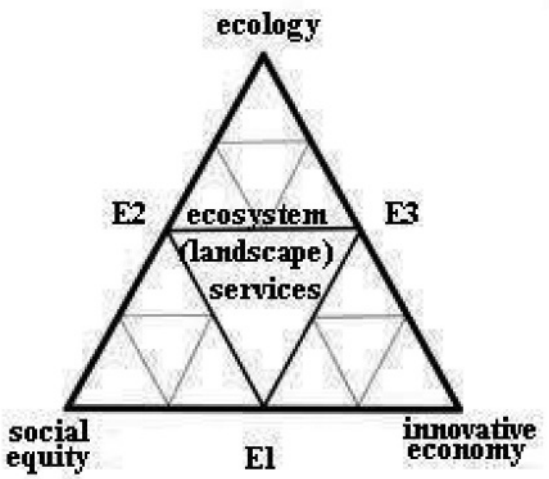


Fig. 1. The position of ecosystem services in the fractal triangle "Innovative Economy, Ecology and Social Equity"

Where are ecosystems services positioned in the triangle of "innovative economy, ecology and social equity" of the Polish mathematician Sierpinski (1916) developed as a tool for visualization of different projects for products, buildings, factories, cities and even countries (Fig. 1). When planning a product or system a move around this fractal triangle accompanied by asking questions and seeking answers is applied. The basic right corner of the main triangle is named "economy", but as economic development nowadays can only happen on the basis of innovation, we define the basic right corner as an "innovative economy". In moving towards the basic left corner of the main triangle, where we place "social equity", we pass through the intersection of one of the vertices of the

large internal triangle with the triangle base (E1). Between vertices of the main triangle "innovative economy" (right) and "social equity" (left) point E1 acts as an optimal focus between innovation and equity. On the next side of the equilateral triangle occupying the space between the tops of "social equity" and "ecology" the intersection E2 illustrates the transition from environmental and occupational health in the social equity sector to the environment where you have to obey the laws of nature. Point E2 is the balance between social and natural laws. On the last side of the main triangle connecting vertices "ecology" and "innovative economy" the gradual transition from the laws of nature to innovative economy passes through intersection E3, thus closing the money cycle. Relevant strategies must be economical at point E3 but with an innovative approach to the economy introducing the category geoecological efficiency. Geoecological efficiency is perceived as imaginary criterion rather than a real measurable indicator (Русев, 2012). Key methodological approaches and mechanisms of geoecological efficiency are the geographic spatial concepts for natural resources', energy production', industry and diffuse cycles based on utilization, recycling and balanced use of renewable resources (Русев, 2012). In the presented fractal triangle (Fig. 1), the labels of two of the vertices of the main triangle are changed from "economy" and "equity" (Braungart & McDonough, 2002) into "innovative economy" and "social equity" and the original also lacks the specification of the refraction focal points of ecosystem (landscape) services, which are the vertices of the internal large triangle (Fig. 1) – E1, E2, E3. Globally the term ecosystem services has gained popularity, although the perception of one of the authors (Асенов, 2010) is that there is no particular difference whether these services are considered within the landscape sphere or the biosphere . In support of this view is the fact that the boundaries of ecosystems of different ranks have always continual character, while the boundaries of the landscape at every level have relatively discrete nature. This implies that the assessment of ecosystem services or landscape services can be performed more precisely within a given landscape. Although fewer in number researchers worldwide perceive ecosystems services as landscape services (Willmen et al., 2012) in Fig. 1 they are used as synonyms. In the current discussion it is more important to determine the position of ecosystem services in the internal large triangle of the fractal figure (Fig. 1), whose peaks reach the intersections E1, E2 and E3 with the sides of the main triangle, considered respectively as the balance points between "innovative economy" and "social equity", between "social equity" and "ecology", between "ecology" and "innovative economy".

The steps for the realization in the innovative economy are: generating innovative ideas and their elaboration to become viable for the market realization; describing the needed intellectual and financial resources and steps for completing the whole volume of activity (in a realistic business plan); providing adequate protection of the intellectual property; ensuring the adequate financing (very often from the venture fund) and starting

the market invasion and providing the necessary scale activity for maximizing the benefits from the global market. For the implementation of these steps it is necessary to establish very sophisticated innovative environment, and all the appropriate structures – Government support of science, modern R&D organizations, sufficient Venture funds, Business Incubators, Business innovation centers, Technology parks, etc., providing technology generation of the new ideas and their commercialization in the economy and business.

The steps for the fulfillment of the other two tips of the triangle – social equity and ecology, can be illustrated by the concept of Braungart & McDonough (2002), assuming that "instead of using nature as a tool for achieving the goals of people we should strive to become an instrument of nature that also serves its purposes".

Discussion

The economic development of each country depends mainly on its richness and the scale of realization of innovative ideas. The wealth of any country is divided between five main types of capital: natural, social, human, manufacturing (productive) and financial. The World Bank assessed the total capital of each country in comparable monetary values (Table 1).

In most of the developed countries unlike non developed ones the relative share of natural capital in the structure of the total wealth is not particularly high, but it represents a significant public interest for several reasons. Natural capital can be used as an incentive to increase the total wealth per capita. The assessment of the "ecosystem services" and equitable redistribution of the value added, according to the contribution of nature in the end result, will allow for the maintenance and the development of this capital. The innovative economy has all the resources to improve the quality of life while reducing pressure natural environment not only by ensuring more accurate understanding, measuring and improving the ecosystems services. It can ensure the conditions for sustainable development.

Table 1. Structure of natural capital in selected countries in the world for 2000 (according to the World Bank – in U.S. dollars per capita)

Country	Population, 10^6	Under ground wealth	Wood resources	Non wood resources	Protected areas	Farm land	Pastures	Natural capital
ALB	3113	300	38	72	247	1660	1574	3892
AUS	18783	11491	748	551	1421	4365	5590	24167
BGR	8170	244	126	102	217	1650	1108	3448
DNK	5340	4173	211	25	1377	2184	3775	11746
FIN	5172	58	6115	1259	1090	843	2081	11445
FRA	58978	87	307	77	1026	2747	2091	6335

Country	*Population, 10^6*	*Under ground wealth*	*Wood resources*	*Non wood resources*	*Protected areas*	*Farm land*	*Pastures*	*Natural capital*
GRC	10707	318	82	101	57	3424	573	4554
IRL	3813	385	222	51	172	1583	8122	10534
MKD	2026	-	-	101	183	2771	646	-
NZL	3858	3596	1648	611	11786	5824	19761	43226
ROM	2334	1222	290	65	175	1602	1154	4508
TUR	65559	190	64	34	86	2270	861	3504
USA	2272639	7106	1341	238	1651	2752	1665	14752

The pace of the economic and social development of society overtakes hundreds of times the rates of the natural growth and evolution of the ecosystems, i.e. the economy is incomparably more competitive than the ecosystems. But the current economy still uses slow recoverable or non-recoverable natural resources for its mad growth. Furthermore a lot of problems in economy are provided to be processed by the "inefficient" environment. These facts caused the extending gap between economy and environment, and existing global environmental problems – pollution, reduced vegetation cover and biodiversity, forest decline, disturbance of macro biological systems and many others. Innovative economy itself is infinitely more competitive to the current economy. But it has a very nice additional feature compared to the classic economy – to solve the problems!

The innovative economy is still evolving. The technologies and people effectively using them are still too new to be well understood. The world will probably need years for its full understanding and acceptation. But some of the elements of innovative economy are already taking shape.

The most important resources in the innovative economy are the exploding quantities of new knowledge (and information). Up to now this element is reckoned to be infinite. The innovative economy means that competitive advantage will award not those who best reduce informational costs, but those who create new informational value for the entire network.

The acceleration of the processes and widening of the social groups who take part in the R&D processes lead to change in the whole society.

There is a very interesting fact about changing the behavior of the customers. They are expected to be surprised by the new features of the new products. And they also want the new products and technologies, by which these new commodities are produced, to be environmentally clean! In the classic economy there is a big discussion between the need of sparing the nature and to ensure the big profits for the polluters. The innovative economy is problem solving and provides its profit on the base of satisfying the customer even in the field of the protecting the environment.

The competition between companies is based mainly on the intellectual properties and starts in the minds of generators of ideas and laboratories. The winners earn the

lion part of the market benefits, including the biggest margins in the profit. The losers drop out to the low income categories or could simply bankrupt (the creative destruction law). The process of creative destruction stems from competition and innovation, which drive changes in the market. "Progress entails…the destruction of capital values in the strata with which the new commodity or method of production competes. In perfect competition the old investments must be adapted at a sacrifice or abandoned" (Schumpeter, 1942). Creative destruction is inevitable in the innovative economy. It should be accepted as a way to be controlled. The entrepreneur must be the one who abandons an old way of living and thinking in order to live and think more productively and profitably. Decades-old giant institutions like Lehman Brothers can disappear overnight, while new ones like Apple and Google can spring up from nowhere.

Several authors mentioned the nonlinearity of the technology development. And it is not just electronics (Moore's law, Kryder's Law, Nielsen's Law). There are similar trends in other industries (solar energy industry, for example.). The differences are in the speed of the changes in the diversity of the industries. This difference created the illusion of continuing the nowadays economic rules.

The point of intersection between the economy and nature are at the entrances and the outputs of the industry. The classical industry adores maximizing profits. It is the reason to neglect the care about the environment. The maximizing of profits at the environment expense is "bad profits" that kill future profits. The innovative economy satisfies the green needs and desires of the customer and creates its profit in quite a different way. Here are some examples. The fossil fuel industry produces 87 %t of the energy that people around the world use. The rising renewable energy industry will change gradually this biggest polluter of the world. The solar energy resources can satisfy about 6.000 to 10.000 times all the human energy needs for billions of years. The prices of the solar devices continuously decrease (Fig. 2).

Several countries have developed special policies to support the whole process of commercializing this kind of energy. For example, Germany invented the "Feed-in-Tariff" policy (the "energiewende"). This is a new kind of policy, which spurs the development of the whole complex of finding new scientific discoveries, developing the new technologies, creating the new customers, establishing the new social climate, building the whole infrastructure. USA, Japan and China successfully implement similar methods of government and society support for the new growing economy. Using similar kind of policy Denmark succeeded to create its wind industry and to gain merely 30% of the world wind energy market. Unfortunately in Bulgaria we misunderstood the innovative policy idea and instead of stimulating the R&D and family roof-mounted projects we jumped only onto the big commercial projects. We import merely all the necessarily devices for €2,5 billion and we aren't able to export produced clean electric energy from

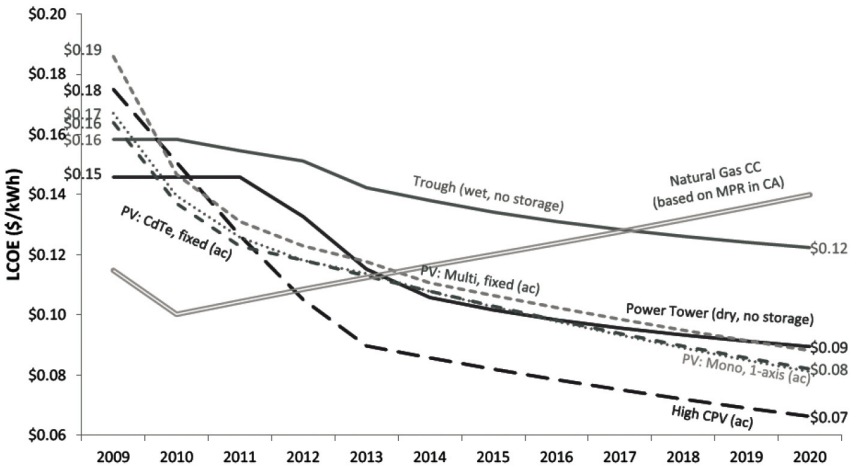


Fig. 2. Comparison between the costs of electricity from renewable energy sources and natural gas (Source: GTM Research)

the PV plants. This non-innovative approach to the new technology created problems with the Bulgarian economy and society. Instead of developing our national participating in this business we tapped and compromised our chances. The renewable energy sources are one of the foundations of the innovative economy and will change not only the classical energy industry, but the whole society.

Today over 1.5 billion people use wood for heating and cooking. This is not only very ineffective technology but created enormous environmental problems. In Africa, the use of wood for cooking has led to the deforestation of much of the continent. In a lot of African countries peoples are looking for ways to replace the wood in this process through the use of solar energy. This problem can be resolved in innovative way using renewable energy sources and will be part of the innovative economy.

The output of the classical industry usually is environmental pollution. One viable trend in innovative economy is scale recycling industry. It will lower the pressure on the environment, but will create new kind of raw material for the industry. The list of similar examples can be continued. But the innovative economy will help the environment not only in the field of new production technologies. There are technologies that can exceed the achievements of the nature. For example, the photosynthesis, which is the basis for maintaining current way of life on Earth, is desperately inefficient process. Its efficiency is 1.5 to 2% (in exceptional cases up to 3%) and at temperatures above 40°C is rendered inoperable. This is a challenge not only to nature, but mainly to mankind. The record

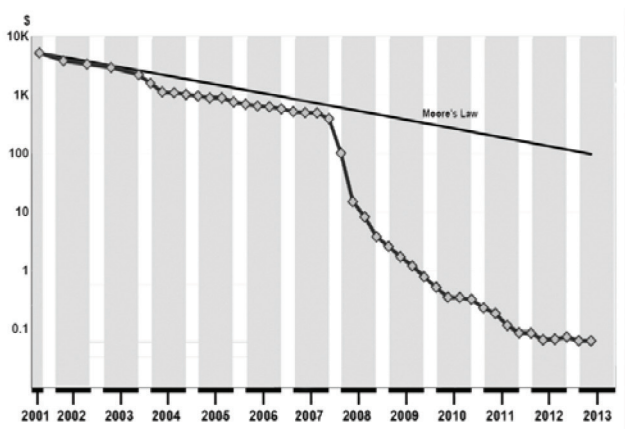
efficiency of converting sunlight into electric power, achieved by the Spectrolab, is higher than 41%. Currently, human achievements in certain areas greatly exceed those of nature. A lot of new ones are on the way to appear. There are a lot scientific and technology research projects under development, which will resolve the nowadays environmental problems in economically effective way. Some of them are in the field of artificial photosynthesis, which will supply economy with organic chemical stuff. The foundations of the new innovative economy are established now in the laboratories and the minds of the innovatively thinking people and entrepreneurs. As Einstein concluded in 1921, the biggest existing problem cannot be solved with the same mindset that brought us to them. The question is not only to switch to "green" and "blue" thinking, but to solve the problems that currently seem to be completely antagonistic. It is the innovative thinking and activity that solves the whole complex of radically opposite interests and behavior.

There is another very interesting aspect: humans are a tremendous evolutionary force. It appears in different ways. For example, some of the species adapted very quickly to the changes. Bacteria evolve quite rapidly reaction to the antibiotics. The genes that ensure the resistance of the bacteria against antibiotics are known as the environmental resistance. It is possible these genes to be transferred from pathogenic to non-pathogenic bacteria, which obtain "artificial" antibiotic resistance.

Another example – Snell-Road & Wick (2013) offer evidence suggesting that altering the environment may fuel the evolution of bigger brains. For two species the brains of animals from cities or suburbs were about 6 percent bigger than the brains of animals collected from farms or other rural areas. The authors conclude that when these species moved to cities and towns, their brains became significantly bigger. In this disrupted environment, animals that were better at learning new things were more likely to survive and succeed to produce next generation, which is a very interesting evidence for intellectual kind of evolution. It enables the individual to adapt himself to the changes, not to wait the next generation. One of the relevant theories assumed that species, capable of rapid population growth, would show more pronounced evolutionary responses, which seemed logical. What about slow population growth species? Is it possible and how to help them to survive? And why they deserve so many efforts? All the living creatures are great wealth for the mankind. They are natural evolutionary achievements, which hide a lot of answers to our science and technologies. We still have a lot to learn from the biosphere, so that we must save it. It would be very useful to create genetics database of all the existing species. This is very effective and reliable way of saving them. And it would be very useful each country to begin with their endemic and the most threatened with extinction species. It would be like the seed banks that were created in the 1970s and 1980s. The Norway's seed bank in Svalbard contains the world's 1,750 seed banks, storehouses of agricultural biodiversity and around two-thirds of the world's stored crop.

A new kind of ecosystem services, additional to the aforementioned four categories, can be defined: the biosphere as a source of knowledge and inspirations for new technologies or practical decisions. Even contemporary biotechnologies are wide spread. In the future their significance will be bigger. There are a lot of pros and cons about genetic code engineering among the scientists. But we must follow the facts, not the ideology. The bans that have been imposed in some countries on GMO crops or foods are political. They were voted in by politicians over the objections of independent international science organizations. Humans have been changing the genetic code of plants and animals for millennia. They have been selecting the best breeding creatures to achieve desirable useful features. As a result of these efforts scientists have learned how practically to read and modify this code. The basis of genetic engineering is the ability to get genetic information carrying useful features from one organism, and add it into another one. This has allowed the researchers to speed up the process of developing new breeds of plants and animals. The process is already widely used in the world to resolve various kinds of problems and one of the popular evidence is so called "golden rice", healthier than conventional and organic crops. The cost of determining the sized genome decline faster that the Moor's law (Fig. 3). It has been the Moor's law that has described the global success of the electronic industry. That would have big consequences – when some row resources or sources of easy income become cheaper, it will be merely impossible to be forbidden. Probably we will witness the next agriculture revolution. In this way the new prolific sources of raw materials for the industry will be ensured. This approach will support the future discoveries or the next technology but the pressure over the nature will not decrease. Competitiveness of the new species may be higher and they may displace natural close taxa from their habitats. It is possible that biomass from GMO will influence the metabolic processes in consumers. The genetic engineering is peculiar kind of intellectual evolution that speeds up the classical one.

(I)



(II)

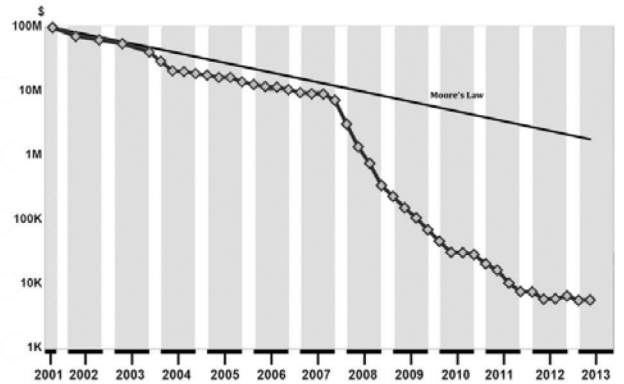


Fig. 3. (I) Cost per Mega base of DNA Sequence – the cost of determining one mega base (Mb; a million bases) of DNA sequence of a specified quality; (II) Cost per Genome – the cost of sequencing a human-sized genome (Source: National Human Genome Research Institute, NIH)

Legend: (I) the use a logarithmic scale on the Y axis; and (II) the sudden and profound out-pacing of Moore's Law beginning in January 2008. The latter represents the time when the sequencing centers transitioned from Sanger-based (dideoxy chain termination sequencing) to 'second generation' (or 'next-generation') DNA sequencing technologies.[3)] However, these data do not capture all of the costs associated with the NHGRI Large-Scale Genome Sequencing Program. The sequencing centers perform a number of additional activities whose costs are not appropriate to include when calculating costs for production-oriented DNA sequencing. In other words, NHGRI makes a distinction between 'production' activities and 'non-production' activities. Production activities are essential to the routine generation of large amounts of quality DNA sequence data that are made available in public databases; the costs associated with production DNA sequencing are summarized here and depicted on the both graphs.[3)]

Conclusion

It is the innovative economy that is called to protect natural capital, reducing the pressure on ecosystems and scarce resources for conservation and regeneration of that capital. It has all the resources to find new ways to save the biodiversity. On the other side it is the biosphere that has enormous quantity of information to influence the new scientific discoveries and innovative technology decisions. It is peculiar kind of big amount of data, which must be saved, studied, explained and exploited in quite a differ-

ent way. It can be regarded as a special new kind of ecosystem services not used up to now. This will enable to raise the standard of living even in the poor countries and in the same time to save the environment. It is very disappointing, that the advantages, which Bulgaria has over anthropogenic loaded Western Europe in areas such as biodiversity and genetic resources, soft tourism and recreation contribute to its lagging in the field of clean technologies and alternative energy, food industry and health care. Ugly results of implementation of the strategy, based only on natural resources, can be seen all over the Bulgarian mountains and the Black sea coast. Creating profits only from the natural resources is so lucrative and seductive, that become lawlessness. The victim of this way of developing is far beyond nature. With the paramount objective of looting and draining public resources, the scheme gradually gripped the entire institutional structure, transforming economic and political life and the very corrupt country into a swamp. Extended to the society this policy causes a moral and value "swamping". The lack of adequate strategies and policies leads even to the downfall of "green" industries, which had begun to appear. They need innovative approach to be developed to the competitive stage.

Today it is especially important to pursue a functioning government policy supporting the development of innovative economy because of the following reasons: (1) avoiding the "swamping" of society; (2) increasing financial cost to start this type of policy; (3) increasing complexity of technological innovation; (4) increasing pressure of internal problems in the country; (5) the possibilities provided by our EU membership; (6) globalization.

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NOTES

1. http://www.ipbes.net/
2. http://www.ecosystemvaluation.org/
3. Additional details about these graphs are provided in http://www.genome.gov/sequencingcosts

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