

12- 18 листопада 2016 р. Вчені Національного гірничого університету (Україна) прийняли участь у Міжнародній науковій конференції «Тиждень країн Східної Європи і країн СНД», що проводилася у рамках мережі NESEFF у Коттбусі (Німеччина)

November 12-18, 2016. Scientists of the National Mining University (Ukraine) participated in the in the Conference «Week of the CIS countries and Eastern Europe», held in the framework of the NESEFF network in Cottbus (Germany)

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Детальніше

The Forum was attended by scientists from four higher educational institutions: Brandenburg Technical University (BTU) Cottbus-Senftenberg, Azerbaijan Technical University, National Mining University (Ukraine) and Moscow Power Engineering University (Russia). The delegation of the National Mining University highly appreciated friendliness, tolerance and respect for human values, expressed confidence that undertaken efforts will lay the foundation for strengthening scientific cooperation between participating universities.

У Форумі прийняли участь вчені чотирьох вищих навчальних заходів: Бранденбурзький технічний університет (БТУ) Коттбус-Зенфтенберг, Азербайджанський технічний університет, Національний гірничий університет та Московський енергетичний університет. Делегація Національного гірничого університету високо оцінила прояв дружності, толерантності і повагу загальнолюдських цінностей, висловила впевненість, що зроблені зусилля закладуть основу для зміцнення наукового співробітництва університетів-учасників. Від Національного гірничого університету представили доповіді проф. Швець В.Я., проф. Бардась А.В., доц. Палехоа Л.Л., доц. Яковенко, доц. Дуднік А.В.



3. INGENIEURTAG 2016

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21. UNIVERSITIES IN FACILITATING TRANSFER OF SCIENCE AND TECHNOLOGY IN ENERGY EFFICIENCY

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ABSTRACT

Global energy crisis has significantly undermined Ukrainian industry, which is the basis of its national economy. For many years, energy intensity in the Ukrainian industrial sector has the highest level in the world. This article focuses on the study of integration of energy efficiency concept into non-environmental study programmes at technical universities.

Keywords: sustainable development, higher education, educational programs, international cooperation between universities.

Main text:

It is argued that energy efficiency today is the essential element of green economy. At the same time, energy factor is usually considered as operating resource without paying attention to its social and ecological function. As a result, Ukrainian students, in particular in Economics, are not provided with knowledge and skills relative to indicators and assessment of energy efficiency for application in management decisions [1].

Lately the most CIS countries had agreed with the need for fundamental reforms of national system of higher education, and currently they are developing an appropriate policy. The role of HEIs is in formation of a new staffing resources or "critical mass" of well-trained and motivated managers, who will make a valuable contribution to the adoption of in-house energy-efficient and sustainable management policies and systems. Reforms of higher education for sustainable society development are set out in the basic programming documents adopted by the governments. Thus, a new Law of Ukraine "On Higher Education" (Version of 09.08.2016) establishes a general outline of the State policy in the field of higher education, based on the principles of sustainability, among which the first and the most important task is: "the promotion of sustainable development through producing a competitive human capital, and creation of conditions for lifelong learning" [2].

In this regard, scientists and specialists have been developing the procedure of making educational process more consistent with European principles and standards. Authors point out that universities should become the "smithy of staff" for moving to wise practices on environment and energy resources management, including the application of energy efficient solutions and environmentally sustainable economic growth approach [3].

However, it should be noted that universities pay so far little or no attention to adaptation of the economical education programs for changing energy requirements of the economy. In particular, specific studies had also confirmed that Ukrainian universities are not paying attention to gaps in knowledge and formation of specific "sustainability and energy mindset" of future managers and non-core specialists (economists, marketers, etc.) [3]. And the required tools for putting these objectives in practice are not clearly described.

At the same time, a number of recent international forums on education for sustainable development explained the vision of related tasks. UNESCO World Conference on Education for Sustainable Development (Aichi-Nagoya, Japan, 10-12 November 2014) and World Education Forum (Incheon, Korea, 19-22 May 2015) emphasized that the transformation of higher education should be comprehensive and multifaceted, also cover the content of educational programs, educational methods and techniques, learning environment and learning outcomes.

Moreover, the Paris Agreement on Climate Change (United Nations Framework Convention on Climate Change, 30 November-12 December 2015) calls upon all Parties to ensure that issues of climate and energy saving are adequately reflected in education and training as their contribution to capacity building for climate action.

In this context, Figure 1 shows the vision of implementation of sustainable development and energy efficiency ideas in the education process in economics.

Content of educational programs in economics – all curricula should include a sufficient range of themes and issues, which are crucial for understanding of sustainability and energy efficiency at the global and local levels (such as the principle of energy efficiency development, the objectives of energy efficiency in management, methods and tools for measuring sustainability and energy efficiency assessment, international energy management standards, etc.).

Educational methods and techniques – methods and teaching practice should contribute to the improvement of education quality and the formation of a new administrative staffs and managers generation through stimulating innovative efforts in the learning and training process (like integration of formal and informal education, development of students' mindset based on the model "challenge - comprehension - responsibility for sustainable development and energy efficiency - well-reasoned decisions", dialogic learning and effective learning communication, etc.).

Learning environment in economics includes two levels of reform:

- (1) Upgrading diverse educational environment (*physical, virtual and online*) as a most effective tools of facilitating the assimilation of systematic and relevant knowledge on sustainable development and energy efficiency.
- (2) Encouraging acquisition and exchange of scientific and professional knowledge, and narrowing the knowledge gaps on methods and tools for sustainable management with special focus on the rational use of energy resources.

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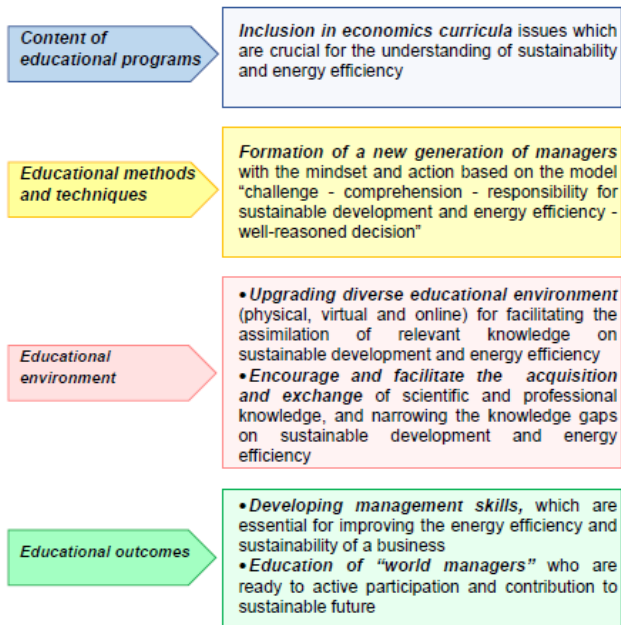


Fig. 1. The implementation process of the energy efficiency and sustainability aspects to educational programs in economics (Source: compiled by the authors based on [3-5])

Educational outcomes include two subsequent levels:

- (1) Developing management skills which are essential for improving the energy efficiency and sustainability of a business.
- (2) Education of managers who are ready to active participation and contribution to sustainable future.

The integration of energy efficiency concept has to be supported by new methods and principles of education, which ensure training of specialists with mindset of energy efficiency and sustainable development (Fig. 2).

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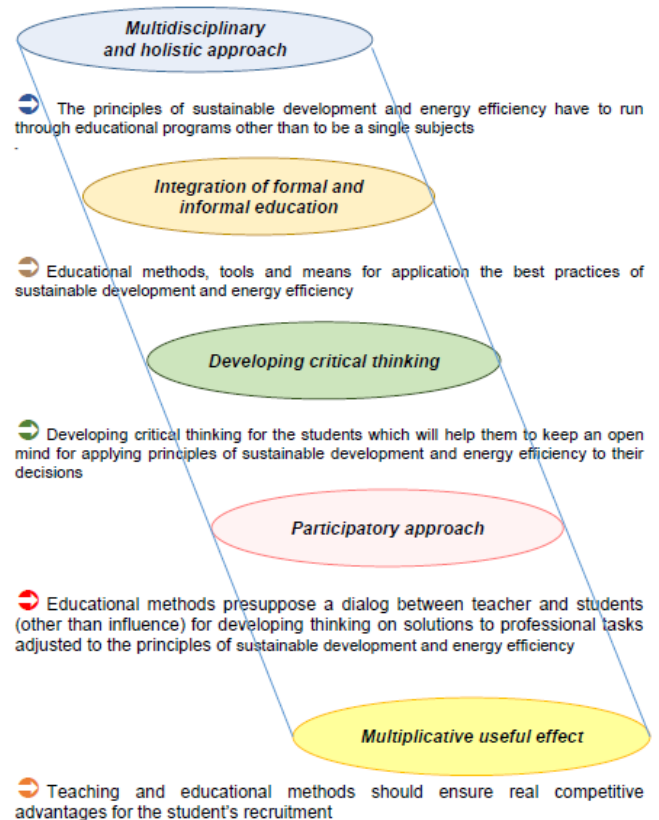


Fig. 2. Educational and teaching methods in the context of sustainable development and energy efficiency problems (Source: compiled by the authors based on [2])

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Integration of energy efficiency concept into educational process in management has to be provided in two directions: including of special disciplines (for example, disciplines on energy efficiency standards) and integration of energy efficiency aspects into core disciplines (compulsory and optional) [4]. Provided approach will give to managers the opportunity to make well-reasoned decisions and to act responsibly for efficient use of resources, ensuring profitability and energy efficiency, and keeping principles of just society for considering the interests of present and future generations.

References

- [1] Shvets V., Palekhova L., Palekhov D., Ivannikov A. (2014) Implementation of sustainable development ideas into economics curriculum. In: *Economics Bulletin*, № 2 (46), pp. 114-119. ISSN 2073-9982
(In Russian: Швец В.Я., Палехова Л.Л., Палехов Д.А., Иванников А.Л. (2014) Имплементация идей устойчивого развития в учебные программы студентов экономических специальностей // *Економічний вісник*, № 2, С. 114-119. ISSN 2073-9982)
- [2] Law of Ukraine "On Higher Education" (Version of 09.08.2016) - <http://zakon5.rada.gov.ua/laws/show/1556-18> (accessed November 16, 2016).
(In Ukrainian: Закон України "Про вищу освіту" (Редакція від 09.08.2016). - <http://zakon5.rada.gov.ua/laws/show/1556-18> (обращение 16 ноября 2016).
- [3] Schmidt M., Palekhov D., Shvets V., Palekhova L., 2015: *Changing the paradigm of higher education for sustainable development. In: Management for sustainable developments in transitional economies: Monograph. Dnepropetrovsk-Cottbus: NMU-BTU, pp. 365-378. ISBN 978-617-7109-91-3*
(In Russian: Шмидт М., Палехов Д., Швец В., Палехова Л., 2015: *Изменение парадигмы высшего образования для целей устойчивого развития // Управление устойчивым развитием в условиях переходной экономики: монография. – Днепропетровск-Коттбус: НГУ-БТУ, с. 365-378. ISBN 978-617-7109-91-3*)
- [4] Shvets V., Palekhova L., Schmidt M., Palekhov D., 2015: *The experience of international universities partnerships in the field of greening education and the development of distance online learning. In: Innovation in higher education - communication and collaboration in a modern university environment with specific digital tools: [international collective monograph]. Ed.: Prof. Nakaznoy M.O. Dneprodzerzhinsk: DSTU, pp.170-181.*
(In Ukrainian: Швец В., Палехова Л., Шмидт М., Палехов Д., 2015: *Опыт международного партнерства университетов в сфере экологизации образования и развития дистанционного онлайн обучения // Інновації у вищій освіті – комунікація та співпраця у сучасному університетському середовищі за допомогою специфічних цифрових інструментів: [Міжнародна колективна монографія]. За заг. ред. проф. Наказного М.О. Дніпродзержинськ: ДДТУ, С.170-181*)
- [5] Shvets V., Palekhova L., Schmidt M., Palekhov D. (2015) *Partnership as a method of promoting a model of higher education for sustainable development. In: Economics Bulletin*, № 3 (51), pp. 146-154. ISSN 2071-2227
(In Russian: Швец В., Палехова Л., Шмидт М., Палехов Д. (2015) *Партнерство как метод продвижения модели высшего образования для целей устойчивого развития // Экономический вестник*. № 3 (51), С. 146-154)

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22. MANAGING THE SUSTAINABLE DEVELOPMENT OF URBAN SYSTEM IN THE CONTEXT OF EUROPEAN INTEGRATION

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ABSTRACT

The article deals with problem of sustainable development of urban systems, analyzes the problem of the transformation of environment in cities, and discusses the methodological approaches to estimate environmental safety impact on economic and social indicators of a city sustainable development.

As we accept that the main question of sustainable development is to balance human needs with environmental safety, we also have to take the point that cities have transformed into such places where destruction of natural environment proceeds at a high pace.

Keywords: sustainable development, urban systems, urbanization, environmental safety.

Main text:

When signing the EU-Ukraine Association Agreement the both sides have recognized Agenda 21 – Sustainable Development Knowledge Platform 1992, Johannesburg Plan of Implementation for Sustainable Development 2002 and internationally agreed policy programs in the fields of employment, social policy and environmental protection to contribute towards the goal of sustainable development and to ensure that this objective is integrated and displayed at every level of mutual relations.

The model of an urban system sustainable development is, like any other models, an integrated system, which components represent main ideas of sustainable evolution of social, economic and environmental processes. There are a number of baselines for implementation of sustainable development principles in a policy at different level of public administration [1]:

- economic development based upon radical modified market interactions;
- natural and environmental sustainability based on biotic regulation;
- international cooperation in politic, social and economic policies;
- sustainable social development based on welfare and equality;
- ecologization of social consciousness be means of mass media and life-long learning system.

As we accept that the main question of sustainable development is to balance human needs with environmental safety, we also have to take the point that cities have transformed into such places where destruction of natural environment proceeds at a high pace.

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Understanding the co-evolution of urban and natural systems is key to build a resilient society and transform our habitat. Cities mainly are going to be developed in places that are the most biologically diverse, but the urbanization affects negatively not only landscapes, but pollutes water sources and air, destroys greenery. While concentrating a huge amount of people on comparatively small areas, most of the cities are known as so-called "demographic black holes" [2]. For instance, in Ukraine has been a strong trend of increasing the number of urban population since 1960; however, the trend become always linear since 2005 as it shown the Figure 1.

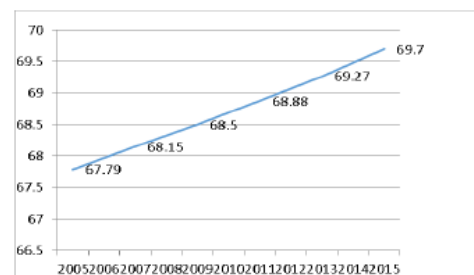


Fig. 1. Level of urbanization in Ukraine, % of urban population [3]

Ukraine's demographic outlook has changed from a country with a modestly high birth rate to one with more rapid aging and a smaller number of young people [2]. During more than three decades, until the middle of 1980, Ukraine's total fertility rate (TFR) was two children or more per woman. This indicator has been shrinking in cities since 1970th and now remains one of the world lowest – 1.5 TFR in 2013 [2].

The changes in crude birth rates, since 1970 until 2012, are shown in Figure 2. Concurrently with decline of crude birth rate the crude death rate has been growing in Ukraine as it shown at Figure 3.

Such a situation has been caused by not only social and economic factors. The birth rates are higher in rural regions and are lower in big cities and urbanized areas. These indicators seem to be worse in the industrialized southern and eastern regions of our country with the highest technogenic impacts on natural environment. This situation is not unique - many industrialized and developed nations have the same negative trends in demography. The specific of Ukraine is rather in a combination of a number of negative factors which are typical both for developed (low birth rate, the social model of consumerism) and developing countries (high levels of pollution of the natural environment, multi-faceted predatory attitude to natural resources, high crude death rate).

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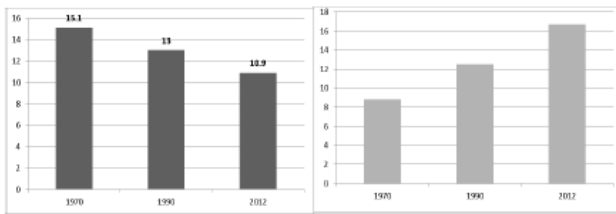


Fig.2. Crude birth rate in Ukraine, 1970-2012, per 1000 people [3] Fig.3. Crude death rate dynamics in Ukraine, 1970-2012, per 1000 people [3]

Overcoming of the current trends is a matter of survival for contemporary Ukrainian society, a necessary condition to maintain its global competitiveness and adapt itself for different challenges. Considering the fact that most of the environmental risks are generated in urban areas - in megalopolises or industrial agglomerations - we need to improve our urban planning and design, enhance the quality of local governments and manage environmental pressures in a better way.

Reforms of urban planning need to separate industrial zones from residential areas develop flexible zoning. Dangerous productions must be removed from urban areas with high density of population and relocated to industrial zones, where risks of technological accidents would be lesser.

It would improve the ecological safety of urban systems. Linking transport infrastructure to residential areas, business and production centers, promotion coordination among metropolitan cities and their satellites would encourage better management of pollution.

The problems described above are not only inherent for Ukraine but have the global scale. As we can see, many developing countries in Africa and Asia have the highest increasing rates of urbanization, as there in 2030 urban population expected to increase up to 54% (in 1.45 times to 2000) and 55% (in 1.49 times to 2000) respectively [4].

World Health Organization has been monitoring on 2,000 cities and based on the gathered figures it affirms that pollution worsening in many countries. It was found that 15 out of the 20 most polluted places were in India and China. The others were in Pakistan, Iran and Bangladesh.

Of the worst 100, nearly 70 were in Asia and only a handful in Europe or the US. Unfortunately, the study did not cover those cities located in the Eastern Europe, like Kamianske, Dnipro, Kryvyi Rih and others, where pollution levels are extremely high and very dangerous for population.

According to a recent WHO study, the cost of disease and the premature deaths caused in Europe every year by air pollution was more than \$1.6trillion in 2010, nearly 10% of the gross domestic product of the EU in 2013, while the UK was estimated to have suffered \$83bn (£54bn) in costs associated with air pollution [6]. Elsewhere in Europe, the figures were Germany \$145bn, and France \$53bn. The highest was in Bulgaria, which spent an estimated 29.5% of its GDP on the costs of air pollution fatalities [6].

If traditional concept of city development explained the worsening of urban environment by necessity of economic growth then modern theories of city's sustainable development pay more attention to creation of safety and resilient urban system, which satisfy both economic, social and ecological demands of local inhabitants. It is possible to do it under condition that local societies must find a consensus over main prospects of city development and create conditions for sustainable economic development of urban systems.

The prestige and international status of cities, prosperity of their citizens, as well as quality of infrastructure and services, depends on this ability to develop sustainably. In our study we are going to find some dependences between a number of social, economic, environmental factors and the attractiveness of land plots in different districts of a city area. This study is considered a basement for developing a methodological approach, which aimed to help local authorities to estimate an impact of environmental safety on economic and social indicators of a city sustainable development.

References

[1] National Paradigm of Sustainable Development of Ukraine, 2016. State Establishment "Institute of Environmental Economics and Sustainable Development of National Academy of Sciences of Ukraine".
 [2] Haub C. Ukraine's Demographic Reality. - <http://www.prb.org/Publications/Articles/2014/ukraine-population.aspx>(accessed October 4, 2016).
 [3] UNESCO. - <http://en.unesco.org/countries/ukraine> (accessed October 4, 2016).
 [4] World Urbanization Prospects. - <https://esa.un.org/unpd/wup/Publications/Files/WUP2014-Highlights.pdf> (accessed August 20, 2016).
 [5] Bardas A., Dudnyk A. To The Problem Of Evaluation Of Natural Resources Potential And Environmental Quality In Urban Settlements / A. Bardas, A. Dudnyk // Economic Bulletin of National Mining University. - 2016, №1 – P.148-155.
 [6] John Vidal. Air Pollution: a Dark Cloud of Fifth poisons the World's Cities. The Guardian. - <https://www.theguardian.com/global-development/2016/jan/16/winter-smog-hits-worlds-cities-air-pollution-soars> (accessed October 4, 2016)

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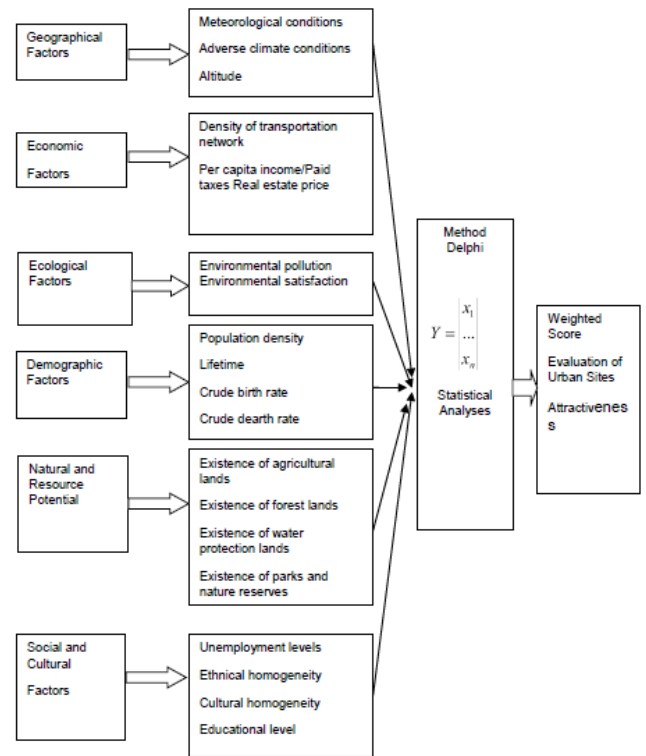


Fig.4. Methodological Approach for Evaluation the Attractiveness of an Urban Territory [5]

23. EXPERIENCE OF USING VOLUNTARY SUSTAINABLE DEVELOPMENT STANDARDS IN ENERGY SPHERE

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ABSTRACT

The main objective of this article was to study the practical aspects of implementing international energy standards as strategic tools to achieve the desired progress in the steel industry. The study highlighted that the overall goal is to ensure 'energy efficiency', 'environmental sustainability' and 'energy equity' as a single, unitary purpose and energy policy action programs. The immediate directions in the energy policy of steel plants will be the following: implementation of the development standards on energy saving and energy efficiency, reduction in GHG emissions by energy efficiency technologies, pursuit of competitive and transparent energy activity.

Keywords: sustainable development, energy efficiency, voluntary energy standards.

Main text:

The voluntary energy standards are recommended for management decisions toward implementation of sustainability principles at the different levels of the value chain, ranging from research and development to production and distribution [1]. The priority form of conformity according to international energy standards is a voluntary certification scheme, which is carried out to establish a control mechanism for compliance with energy efficiency criteria in production and management [2].

Recent literature on energy issues and sustainable development clearly demonstrated that energy certification should not be viewed only as a cost, but as a promising investment project, opening up new business opportunities. Voluntary energy certification is a procedure which confirms the compliance of the certified facility (products or management) with the requirements defined by the international standards on energy sustainability; this will allow us to overcome a crisis trend in energy-intensive industry sectors [3-4].

As for Ukraine, for many years country firmly occupies a leading position in the world ranking of energy intensity of the industrial sector. In 2015, the unit consumption of steel industry in Ukraine is 0.59, in Russia – 0.76, while for Germany – 0.31 (See Fig. 1-2).

Today, in energy sustainability index (calculated by the World Energy Council) among 125 countries Ukraine took the 63th place, Russia – 45th place, and Germany – 5th place (see Fig. 3-4).

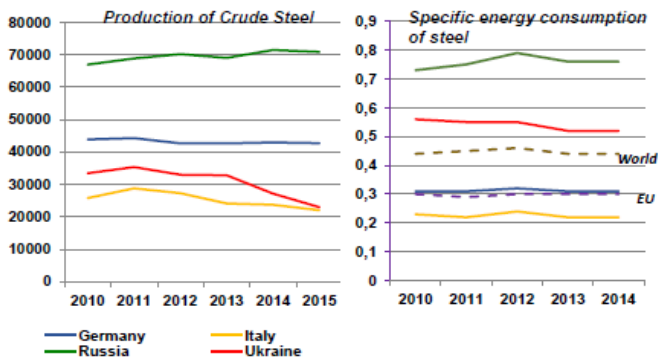


Fig.1 Total production of crude steel (Includes all qualities: carbon, stainless, and other alloy; in thousand metric tons) (Source: own compilation based on [5-6])

Fig.2. Specific energy consumption in the steel industry by countries (toeft) (Source: own compilation based on [7])

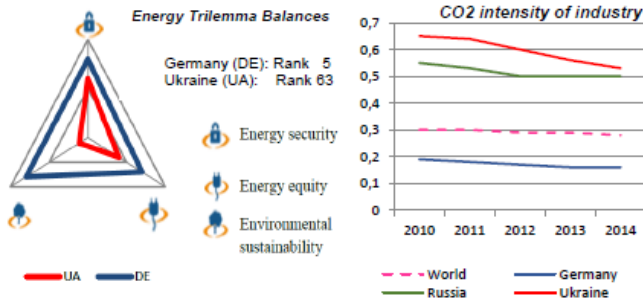
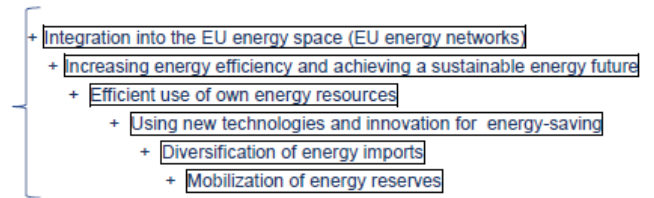


Fig.3. Comparison between the Energy Trilemma Balances of Germany and of Ukraine, 2016 (Source: calculated by [8])

As we can see, Ukraine is far behind in all indicators, especially in terms of environmental sustainability. At the same time, the review of several studies indicates that Ukrainian steel enterprises increasingly integrate energy aspects into their core business and supply chains. Such facts are based on application of some methods of strategic planning, energy sustainability considerations into economic and developmental decision-making [8].

After the signing Association Agreement with the EU, Ukraine should set itself goals that are comparable with EU objectives. The basic configuration of the new energy program of Ukraine is represented by the following formula:



The best world practices on energy management showed that countries have taken different approaches to tackling energy efficiency (See Fig. 4-5). However, today the voluntary energy certification is based predominantly on the ISO 50000 family of international standards. Among the most significant benefits for enterprises certified to ISO 50001 can be noted: increase of competitiveness due to the recognized international certificate; increase of investment attractiveness due to the reduction of risks associated with the energy demand, other positive effects [12].

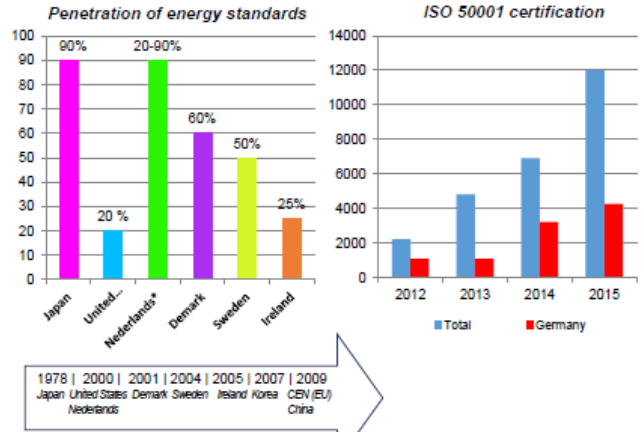


Fig. 4. Penetration of energy management standards in time and country (Source: [9])

Fig. 5. Dynamics of ISO 50001 certification (Source: calculated by [11])

In Ukraine, The EMS certified under the ISO 5001 was introduced in a five large steel holdings, such as: 'Azovstal iron and steel works', PJSC 'Khartsyzsk Tube Works', 'Ilyich Iron and Steel Works' of Mariupol (MMKI), JSC 'Zaporizhstal', 'Yenakievo Steel Plant' (EMZ).

Among the factors, that are important drivers for Ukrainian steel enterprises certified to ISO 50001, can be noted the reduction of energy consumption and the level of costs, and the reduction of energy and environmental risks with energy supply. Moreover, JSC 'Zaporizhstal' has not only improved technology in production, but also involved employees in a process by holding a special contest aimed at reducing the consumption of fuel and energy resources.

However, Ukrainian enterprises also face significant barriers on the way of implementation of ISO 50001. The most common ones are that Ukrainian top managers do not really know the principles of sustainability management and do not see the connection between the implementation of ISO 50001 and competitiveness. Among the barriers for steel enterprises certified to ISO 50001, also can be noted the lack of information and exchange of experience, and lack of government measures to stimulate the implementation of ISO 50001 [9; 12].

References

[1] Hansmann B., Palekhov D., 2016: Objectives and functions of voluntary sustainability standards in global value chains. In: Management for sustainable developments in transitional economies: Monograph. Dnepropetrovsk-Cottbus: NMU-BTU, PP. 14-24. ISBN 978-966-921-006-7
(In Russian: Б. Хансманн, Д. Палехов. Задачи и функции добровольных стандартов устойчивого развития в глобальных цепочках создания стоимости // Управление устойчивым развитием в условиях переходной экономики: монография. – Днепропетровск-Коттбус: НГУ-БТУ, 2016. - С. 14-24. ISBN 978-617-7109-91-3)

[2] Shvets V., Palekhova L., 2015: Energy strategy of Ukraine: modern challenges. In: International workshop "Energy supply and energy efficiency", TU Azerbaijan, Baku. Cottbus: Brandenburg University of Technology Cottbus – Senftenberg, PP. 7-9. ISSN 3-9810211-8-5

[3] Palekhova L., 2014: Economic instruments for integrating climate change considerations into development strategies of industrial regions in Ukraine – experience and issues. In: Implementing Adaptation Strategies by Legal, Economic and Planning Instruments on Climate Change / Environmental Protection in the European Union. Volume 4. Springer Verlag: Berlin-Heidelberg, PP. 171-180. ISBN 978-3-540-77613-0

[4] Pivnyak G., Shvets V., Palekhova L., 2015: Standards for responsible mining. In: Management for sustainable developments in transitional economies: Monograph. Dnepropetrovsk-Cottbus: NMU-BTU, PP. 18-32. ISBN 978-617-7109-91-3
(In Russian: Пивняк Г., Швец В., Палехова Л., 2015: Стандарты ответственного горнодобывающего производства // Управление устойчивым развитием в условиях переходной экономики: монография. Днепропетровск-Коттбус: НГУ-БТУ, С. 18-32. ISBN 978-617-7109-91-3)

[5] World Steel Association. Steel Statistical Yearbooks 2010 to 2016. – <https://www.worldsteel.org/statistics/statistics-archive/yearbook-archive.html>

[6] World steel in figures 2016. – <http://www.worldsteel.org/media-centre/press-releases/2016/World-Steel-in-Figures-2016-is-available-online.html>.

[7] Specific energy consumption of steel, 2016. – <https://www.wec-indicators.enerdata.eu/world-final-energy-intensity.htm#/unit-consumption-of-steel.html>.

[8] World Energy Council. – <https://trilemma.worldenergy.org/#/energy-index>.

[9] Palekhova L., Simon S., 2016: Competitive advantages through the implementation of international energy management standards. In: Bulletin of Prydniprov'ska State Academy of Civil Engineering and Architecture, № 3 (216). PP. 42-51. ISSN 2312-2676.

[10] Palekhova L., Kizilova M., 2015: Voluntary energy-efficiency standards as an instrument of competitiveness on industrial markets. In: Bulletin of Tula State University. PP. 405-412. ISBN 978-5-7679-3246-7

[11] ISO Survey-2015. – <http://www.iso.org/iso/home/standards/certification.htm>

[12] Shvets V., Palekhova L., Simon S., Palekhov D., Mammadov A., 2015: Convergence of energy efficiency policies in the EU and countries with economies in the transfer. In: Social, economic and environmental problems of mining, construction and energy. Tula State University, Tula, PP. 398-405. ISBN 978-5-7679-3246-7