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Future Considerations for Developing Energy Efficient Economy in Ukraine using Light Emitting Diode (LED) Enginery on the Basis of NBIC-Technologies

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Received: 12 February 2015 Accepted: 4 March 2015 Published: 15 March 2015

Abstract

The article deals with the prospective directions in creating energy efficient economy with using energy saving light-diode hardware on the basis of nano-bio-info-cogno- (NBIC) technologies. Ukraine experiences considerable import of fuel energy resources, which poses a threat to the state energy safety. The situation drives the need to implement a comprehensive research and design hardware to decrease production energy/output ratio, increase energy efficiency and diversify energy sources. At the same time implementation of energy saving hardware on the basis of NBIC-technologies into developed countries economies requires reviewing of the prospects for its utilization to develop light-diode enginery in Ukraine.

Index terms— energy saving economy, energy efficiency light-diode hardware, NBIC-technologies, environmental pollution abatement

1 Introduction

s of today, Ukraine experiences considerable import of fuel energy resources, which poses a threat to the state energy safety. The available outdated technologies stimulate "production wastage", provide for directive, but not market, pricing, stimulate inefficient work of power engineering companies and, especially important in this context, sectoral science declension. The situation drives the need to implement a comprehensive research and design hardware to decrease production energy/output ratio, increase energy efficiency and diversify energy sources. Ukrainian energy strategy till 2030 stipulates economy restructuring (first of all -decreasing GDP drop) at the expense of state reforms (e.g., public-private partnership in technological upgrading of enterprises, implementing a standardized auditing system, setting a state expertize in implementing renewable energy sources, etc.); structuring adjustment and technological remodeling of economy by the way of decommissioning worn out and outdated equipment, implementing innovative and investment projects; utilizing solar, wind, geo-thermal energy as well as biomass energy; implementing energy saving light diode hardware on the basis of super modern nano-bio-info-cogno-(NBIC) technologies.

The named problem was tackled by many renown scientists, including also M. Roco, W. Bainbridge, B. Tonn, G. Whitesides **??**1; 2], who studied the issues of knowledge, technologies and society convergence; L. Foster [3] worked with the issues of using nano-technologies for power engineering and energy efficiency enhancing; A.Kazantsev, V. Kisilev, D. Rubvalter, O. Rudenskiy [4], P. Maltsev [5], F.Rahman [6], together with Ukrainian scientists M. Kizim, I. Matyushenko, I. Buntov, O Khanova **??**7; 8; 9; 10] Indexing Terms /Keywords: energy saving economy, energy efficiency light-diode hardware, NBICtechnologies, environmental pollution abatement.

developed countries economies requires reviewing of the prospects for its utilization to develop light-diode enginery in Ukraine.

The article aims at studying design and production trends for light diode lighting sources and systems on their basis using NBIC-technologies to achieve considerable costs decrease of electric power used for lighting, as well as quality increase and environmental pollution abatement.

2 II.

3 Method/approach

Content analysis has been used as the main method of research, which allowed making a meaningful analysis of classic papers and researches of modern economists-practitioners devoted to the peculiarities of the modern prospects of energy saving hardware into developed countries economies requires reviewing of the prospects for its utilization to develop light-diode enginery in the World and Ukraine with using of NBICtechnologies.

General scientific methods make up a methodological foundation of the research. They include: description, comparison, statistics review, system analysis and others, which help characterize this phenomenon development in a more comprehensive way. We also apply the methods of dialectic cognition, structural analysis and logic principles that provide for making authentic conclusions as regards the investigated topic.

Official statistical data of the state institutions and international organizations, publications of reference character, analytical monographs, annual statistical bulletins, Ukrainian National Academy of Science reports as well as annual Ukrainian State Statistical Bureau reports serve as an information grounds for our research.

4 III.

5 Results and Discussion

Normal or Body Text a) Program-targeted actions of the Ukrainian government on reducing of the energy intensity of gross domestic product and optimization of the structure of energy balance of the state in 2010 -2015

Sustainable development of modern civilization and the life quality of population is directly related to insufficient energy supply, which raises the urgent need to tackle the problems of resources depletion which are used with existing technologies. But namely the energy problems cause periodic global crises and stimulate the search of unconventional ways to meet the energy needs of any country in the world [1]. The analysis of events of the last decade leads to the conclusion that the world is approaching the global energy crisis. This is due to the limited proven and affordable stocks of organic hydrocarbons. Conclusions of all analytical centers are similar: oil and natural gas will last for 50 years, coal -for 100 years (data are divergent, but not dramatically). Through these forecasts is not expected reduction in cost of oil and gas to the level of the 80s of the last century through the redistribution of their flows, especially considering concomitant geopolitical conflicts. Criticality of gas problems could weaken shale gas, but this is unlikely to fundamentally change the situation, given the constantly growing demand for hydrocarbons **??**3; 7].

In order to reduce the energy intensity of gross domestic product and optimization of the structure of energy balance of Ukraine was adopted a Resolution of the Cabinet of Ministers of Ukraine No. 243 dated March 1, "On approval of the State Target Economic programs of energy efficiency in 2010-2015". [11]. The aims of the For the implementation of the mentioned program there were 3 possible ways of solving problem.

The first method involves the development and implementation of individual sectoral and regional energy efficiency programs under the Cabinet of Ministers of Ukraine order No. 1567 dated December 17, 2008 "About programs of energy efficiency and decrease of energy resources consumption". However, as practice shows, in the case when sectoral or regional program is not a part of relevant government program, it is impossible to achieve a significant reduction of the level of energy intensity of gross domestic product and optimization of the structure of energy balance of the state.

The i. Expected to solve the problem by the following way:

introduction of new production technologies and energy consumption, cogeneration technologies as well as technologies that involve the use of heat pumps, accumulation electric heater heating and hot water supply; -use of solar energy and geothermal energy; -excavation and use of natural gas (methane) of coal deposits and shale gas as alternative fuels; -production and use of biofuels; -development of wind energy, small hydro and bioenergy; -modernization of gas transportation system, system of heat and water supply, heat power plants and combined heat and power plants; -implementation of measures to reduce consumption of energy sources agencies held by the state budget; -reduction of environmental pollution; -legislative regulation of issues related to reducing the level of energy intensity of gross domestic product and optimization of the structure of energy balance of the state, adaptation of national legislation in the field of energy efficiency, energy saving and alternative energy to the European Union legislation; -creating of favorable conditions for attracting domestic and foreign investment in energy efficiency and saving in order to optimize the structure of energy balance of the state, reducing emissions of polluting substances; -formation of state monitoring system and control over the efficient use of energy resources, energy carries production from renewable energy sources and alternative fuels, sectoral and regional energy efficiency programs, improve the reliability of statistical information on energy performance; -restructuring of companies which is aimed at reducing material and energy intensity of production; -improving the mechanism of financing activities that require state support and aimed at reducing the energy intensity of gross domestic product, increase use of alternative energy sources and secondary energy resources, reduce emissions of polluting substances; -enhance international cooperation in the framework of the implementation of state energy security strategy; -popularization among the general public through the media the effectively and economical consumption of fuel and energy resources, inclusion of relevant issues to programs of educational institutions, creation of regional education centers to inform the public. Term of implementation the Program is

consistent with the stages of realization the Energy Strategy of Ukraine till 2030 as the base document for energy efficiency and energy saving.

ii. The main objectives of the Program are: improving legislation and standardization system in the field of energy efficiency, renewable energy and alternative fuels by: development technical specifications and standards in the field of energy efficiency, renewable energy and alternative fuels;

adaptation of national legislation in the field of energy efficiency, renewable energy and alternative fuels to the European Union; -reduction of technological costs and non-energy losses due to modernization of equipment, introduction of modern energy efficient technologies, improving the system of state management and promoting energy efficiency, in particular by: -renewal, upgrading energy-intensive industrial process equipment of enterprises; -sanation of apartment houses, social facilities and building of institutions that are fully funded from the state budget, including development of project and estimate documentation; -reorganization of social facilities that are fully funded from local budgets; -development of model projects on upgrading and replacing boilers with their transfer to alternative fuels, installation of heat pumps, the introduction of technology of accumulation electric heater heating and hot water supply at the objects of communal ownership and social sphere, introduction of -to stimulate industrial enterprises to modernize boiler rooms, implement energy effectiveness equipment, technologies, materials and realization of related works by compensating part of the cost of projects; -modernization and replacement of boilers with their transfer to alternative fuels projects with implementation technologies of heat pumps, accumulation electric heater heating and hot water supply at the objects of communal ownership and social sphere and introduction of cogeneration technologies using alternative fuels in the field of communal heat power system; -modernization of gas transportation system, equipment for heat power plants, combined heat and power plants; –construction and reconstruction of electric networks, building of station units, substations and electrical networks for connecting facilities that produce electricity from renewable energy sources; -construction and reconstruction of local networks, station units and substations for connecting facilities that produce electricity from renewable energy sources; -equipping business entities in the production of heat energy of communal ownership with accounting devices of heat energy actual delivery and residential buildings with house devices of accounting; -stimulate population to implement energy efficiency measures through reimbursement of the loan involved in the acquisition of boilers using any fuels and energy (excluding natural gas); -realizing measures aimed at building in society the conscious relation to the need for energy efficiency, development and use of renewable energy sources and alternative fuels;

iii. optimization of the structure of energy balance of the state, in particular the replacement of traditional energy resources to the other types, including obtained from renewable energy sources and alternative fuels and secondary energy resources by:

construction of power generating capacity from wind energy; -realization of projects on construction of solar plants for production of electric and heat power, installations for the production of biodiesel and bioethanol fuel, synthetic fuel; -restoration of small hydro energetic and construction of new capacities; –projects on construction of installations for solid biofuel and biogas for heat and power; -realization of pilot projects on construction plants for electricity generation using biomass, construction of geothermal power plants using associated gas;

development of feasibility study and project of construction of typical modern mini heat power station that runs on biomass and other alternative fuels; -introduction technologies of using industrial gas and low-pressure gas which is produced from oil and gas deposits for heat and electric power; -realization of projects of peat processing and production of peat briquettes, milled peat; -scientific and technical support of implementation the Program, including conducting research and development work in the field of energy carries production from renewable energy sources and alternative fuels; -creation a system of monitoring energy carries production from renewable energy sources and alternative fuels under the Programme activities; -implementation a research of potential of regions on the placement the objects of renewable energy; -implementation a research of the current condition of small hydro power plants; -implementation a research of wind potential, including the identification of priority areas for the location of wind farms and install measuring equipment.

Sanation of apartment houses, social facilities and building of institutions that are fully funded from the state budget is a complex of technical measures aimed at their recovery and bringing their heat characteristics in line with modern requirements, norms and standards, reducing energy and water losses, and improve conditions of workers.

iv. Works of sanation include:

thermoisolation of external walls of buildings, basement and foundation; -modernization of the roof with possible installation on it solar collectors; -modernization of heating, plumbing, sewer, ventilation and electrical networks of building, transfer it to accumulation electric heater heating; -replacement of radiators, installation of accounting devices of energy sources and water, introducing multiple electricity accounting; -construction or modernization of boiler room in the building; -improvement or repair of heating units; -installation of windows, balcony blocks and front doors.

-Energy efficient equipment, technologies, materials which are implemented using the mechanism of compensation of interest at the rate specified on loans obtained borrowers in financial institutions, and relevant works are:© 2015 Global Journals Inc. (US) 1 (B)**10**

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v. for single-family houses:

gas boilers with automatic natural gas supply, including the cost of installation;

electric boilers, including the cost of installation; -boilers which run on alternative fuels, including the cost of installation; -heat pumps, including the cost of installation; -solar collectors for production of heat energy and water heating, including the cost of installation; -solar panels for production electricity, including the cost of installation; -radiators with thermostats, accounting devices for gas and water, including the cost of installation; -windows, balcony blocks and front doors, including the cost of installation; -works with external insulation of building walls, basement and foundation; -works on modernization of heat, plumbing, sewer, ventilation and electrical networks in the home;

vi. for apartments in apartment buildings:

radiators with thermostats, including the cost of installation; -accounting devices of hot water with temperature control, including the cost of installation; -accounting devices for gas and cold water, including the cost of installation; -windows, balcony blocks and front doors, including the cost of installation; -works with insulation of external walls of apartment buildings.

-Program implementation will allow:

reduce the energy intensity of GDP by 20% compared with 2008 .; -optimize the structure of energy balance of the state, in which the share of energy carries obtained from renewable energy sources and alternative fuels will be in 2015 at least 10%; -improve the country's energy security level and competitiveness of the national economy; -reduce Ukraine's dependence on imported energy, the consumption of fossil fuels, technogenic impact on the environment and improve level of environmental safety of heating systems; -create jobs; -improve the mechanism of state management and regulation in the field of energy efficiency, saving and alternative energy, optimize structure and volume of energy consumption; -reduce the production costs by 10%, nonproduction energy carries losses by 25% of the relevant parameters which were in force at the time of adoption of the program; -eliminate cross-subsidies in the tariff and pricing; -partly solve the problem of payment of arrears from the payment of consumed energy resources; -create conditions for attracting financial resources needed to upgrade and modernize production facilities; -increase the economic and energy efficiency and level of reliability of power equipment of heat power plants, combined heat and power plants;

optimize the structure of energy balance of the state, in particular to secure the reduction of the share of natural gas and oil products, coal and peat, replacement them by other types of energy resources, primarily obtained from alternative energy sources and secondary energy resources. As a result of implementation of the program the amount of substitution of natural gas in the energy balance of the state should be since 2016 at least 15 bln cubic meters, and oil products -1 mln tons; -increase the level of heat supplies to the population and reduce the use of natural gas for heating housing by 60%, of buildings of budgetary institutions -by35%; -reduce the volume of state budget to finance the provision of public utilities in energy budget institutions by 50%; -secure a reduction by 25% consumption of imported natural gas; -reduce the amount of capital investment in the replacement of the heat power equipment on municipal energy plants, industry and oil and gas industry; -reduce by 20% the power intensity works on transportation, storage and distribution of gas compared with 2008, to increase the reliability and energy efficiency of the transit of natural gas pipelines; -decrease by 15-20% the volume of use natural resources (water, minerals, air, etc.) by reducing the consumption of energy resources; -provide 15-20% reduction of emission of polluting substances; -increase the level of public services for all segments of the population with a simultaneous decrease in tariffs for such services; -decrease the social tension by reducing emergency stopping heat power plants and electricity distribution networks.

In addition, March 16, 2011, the joint meeting of the Presidium of the National Academy of Sciences of Ukraine and the Board of the State Agency for Energy Efficiency and Saving on the subject: "Problems of energy efficiency and development of renewable energy, ways of their solutions" [12].

At this meeting it was noted that in Ukraine there is a significant import of energy resources that threatens the energy security of the state. In particular problems that stimulate industrial waste are directive, not a market pricing, inefficiencies of work in the power enterprises and, importantly in this context, the decline

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Volume XV Issue V Version I Year 2015 (B) of sectoral science. It is therefore necessary to carry out complex of actions to reduce energy intensity, increasing of energy efficiency and diversification of energy sources. These actions should be: restructure of economic (primarily -reducing growth of GDP) by government reforms (i.e. public-private partnership for technological modernization, standardized system of audit, state expertise on the introduction of renewable energy sources, etc.); structural and technological restructuring of the economy by removing outdated morally and physically worn-out equipment, the use of innovative and investment projects; potential use of solar, wind, geothermal and biomass energy. In addition, the Energy Strategy of Ukraine till 2030 requires scientific justification, considering the economy condition of Ukraine. To find new solutions and approaches to improve issues of the energy efficiency of the country is necessary domestic scientific support, for which the State Agency for Energy Efficiency and Saving appealed to the National Academy of Sciences of Ukraine, and this meeting was the first step in this implementing into Ukrainian economy a new technology of "solid-state lighting" to ensure considerable decrease of costs of electric power used for lighting, its quality increase and ecosystem's load abatement [13].

Achievements in the area of optoelectronics with using NBIC-technologies provided for creating light diode

lighting systems with the energy efficiency, which exceeds incandescent lamps efficiency 8-12 times. Utilization of such sources provides for considerable decrease of energy costs used for lighting and electric grid management, enhance the level of environmental safety, and streamline the design of automated systems to manage lighting grids and light signaling equipment. According to the experts of Ukrainian National Academy of Science, replacement of 30% of incandescent lamps in Ukraine with light diode lighting sources would provide for saving 13.8 bln. kWh/year of electric power and decrease carbon emission into atmosphere by 7.8 mln. tons. The first technological installation for generating heteroepitaxial structures on the basis of GaN was adjusted and commissioned; the setting of the 2 nd installation was started. Those structures would be the foundation for designing blue light diodes, the radiation of which in combination with broad-band luminophors yields white light.

7 Installations to generate the materials would be the foundation to design blue light diodes

The first luminophors' experimental samples for white light diodes on the basis of organic and non-organic compounds were designed.

8 Luminophors samples for white light diodes

Experimental sample of air-tight technological box to coat light diode structures in the protecting atmosphere of inert gas was designed, manufactured and installed; hardwaresoftware suite for coating light diode structures with protective organic sealing was commissioned Hardware-software suite for surfacing ligcoating diode structures with protective organic sealing Production of light diode emitters and their systems Technological line to assemble experimental samples of powerful light diodes in "clean corridor" module was designed; light diodes experimental samples of 4 W, 12 W and 16 W capacities were manufactured with using imported crystals. The most prominent implementation results of the Target Scientific-Technical Program "Development and implementation of energy saving light diode light sources and lighting systems on their basis" for 2009-2013 Table **??** :

9 Light diodes experimental

proof lighting for miners were designed and manufactured powerful light diodes and experimental samples of explosion proof lighting for miners On the basis of induced birefringence effect a polarized modular appliance was manufactured with a specific feature to perform a full Stokes-polarimetry analysis of partially polarized radiation Polarized modular appliance to perform a full Stokespolarimetry analysis of partially polarized radiation Designing means to diagnose and certify light diode light sources Measuring system for contact-free dynamic testing of light diodes' radiation and heat parameters in the visible range with high time (10 µs) and space (? 20 µv) bifurcated capacity was commissioned.

Measuring system for contact-free dynamic testing of light diodes' radiation and heat parameters in the visible range with high time **??** The method of obtaining film-type organic-nonorganic hybrid nano-composites on the basis of poly-epoxy-propyl-carbazol and quantum-size CdS nano-crystals was tested

The method of obtaining filmtype organic-nonorganic hybrid nano-composites Films of aluminum-nitride of polar and non-polar orientation were obtained on sapphire chip for the first time; they are prospective for designing hetero-structures that provide for considerable light diodes quality increase Hetero-structures that provide for considerable light diodes quality increase were designed Production of light diodes emitters and their systems First Ukrainian light diode lamps of 3 W to 8 W capacity in different structural modifications were designed and commissioned into production. 2 types of ceiling light diode lamps with the improved light distribution and enhanced energy efficiency were designed. Comprehensive implementation of light diode lighting systems at socially important Ukrainian sites was started: 4 major highways (Kyiv -Odesa, Kyiv -Kharkiv, Kyiv -Lugansk, Kyiv -Vyishgorod); 3 universities (Kyiv, Kharkiv); lyceum (Chuhuiv); hospital «Okhmatdyit» (Kyiv).

Composed according to [14-18].

IV.

10 Conclusions

The performed research proved that arrangement of Ukrainian production of light diode light sources with using NBIC-technologies would help develop : energy saving light diode lamps with caps similar to incandescent lamps caps ; lighting appliances to satisfy needs of housing-municipal economy ; special fire-and explosion-safe lamps for miners, ore workings, fire-hazardous sites of oil&gas and chemical industries ; street light diode lamps ; ceiling light diode lamps to light administrative buildings and industrial sites ; light diode illumination systems to light buildings and facilities ; special purpose lighting systems ; lighting systems for transport, etc.

Industrial production of energy saving light diode lighting sources, energy consumption of which is 8 -12 times less in comparison with incandescent lamps, with the service life of 50,000 hours, would help save nearly 400 mln. kWh/year of electric energy for each million of light diode lamps. If using 5 -7 mln. light diode lamps, the aggregate saving on electric energy cost decrease would be 720 -1000 mln. UAH per year, provided the electric power price would be 0.36 UAH per 1 kWh.

10 CONCLUSIONS

285 To develop national branch of light diode lighting hardware it is expedient to attract and concentrate investment
286 funds with the help of a newly set specialized open joint stock leasing company, the profile activity of which would be to lease out light diode lighting hardware. [1] [2]

Figure 1:

Year	Program direction	The most prominent results	Practical value
2009	Designing materials, technologies and methods to control thermo-regulation of lighting sources		light diode

Figure 2:

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