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Towards a Green Economy: The Importance of Environment, Energy and Technology in the European Region

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Abstract. In a world increasingly caring for the development of the economy which minimizes damage to the environment, attention is focused towards a green economy, the core values of which focus on search for alternatives of energy, environment alternatives that allow not to increase the resource usage volumes and the negative impact on the environment. Economic and social inequalities in the development of the European region, become one of the biggest dangers of green economy development, therefore this article analyses the European region's Environment, Energy and Technology Indicators, focusing attention on green economic development opportunities of the European Union and Ukraine.

Introduction

The biggest challenge and the growing problem of the modern world is the climate change. All the countries across the world pay great attention to the fight against this phenomenon. The agreement, which was reached during the COP 21 forum, held in Paris, explicitly provides for the need to stop global warming to 2°C, and this can only be achieved by limiting and in the future completely eliminating the use of fossil fuels for energy, industry and transport sectors. Scientific estimates show that the attainment of fossil fuels should be gradually ceased to be used around the world by 2050 [1]. The European Parliament is among the first ones in the world that responded to climate change by adopting new legislation aimed at contributing to the greenhouse gas emissions reduction (20 percent), encouraging companies to invest in green technologies, to receive 20 percent of energy from renewable sources, and shift to a green economy that is less dependent on expensive imports of fossil fuels [2]. The European region needs to support investment in technologies in order to reduce dependence on imports of resources, which are both resource-efficient and makes it possible to reduce carbon dioxide emissions by switching to the economy of technologies and helping to increase the competitiveness of the European region [3,4]. Long-term global trends lead to promotion of Green economy as they are associated with the increasing lack of resources and rising energy, raw material prices, adjusting the rich and the poor countries' economic development objectives, reducing dependence on the exploitation of natural resources, environmental damage and reducing the regional division, what is especially true in the European region, which includes developing countries, such as Ukraine as well. Analyzing and evaluating the green economy implementation perspectives, concepts such as climate change, environment, energy, technology become of particular interest not only in shaping the political objectives and strategies, but also in scientific researches, analysing and evaluating different regions' economy transformation processes and the basic green economy development indicators [4,5,6]. Therefore, the purpose of this article is to make Environment, Energy and Technology Indicators analysis, revealing the perspectives of transition to a green economy in the European region.

The research methods are as follows: systematic analysis of scientific literature; logical, comparative and mathematical analysis. The analysis was conducted with the use of comparative method which consisted of statistical data published by the World Bank [7].

Green Economy Evaluation Indicators

Green economy is defined as an economy where a human life well-being and social equality is developed by significantly reducing harmful effects on the environment. Green economy seeks to reconcile economic, social and ecological concepts of sustainable development. This is done by emphasizing not only that future generations should be guaranteed the same amount of income, which a current population has, but also the fact that economic prosperity should be created by maintaining social justice and the environment unharmed.

The energy sector has the greatest impact on the economy and climate change, which contributes 8 percent of world's GDP but the consequence of the development of this sector is as much as 40 percent of all greenhouse gases. Therefore, while developing a green economy it is necessary to save energy, because of the lower costs for it would promote the growth of other sectors and efficient use of energy methods would ensure lower greenhouse gas emissions [8]. The transport sector is becoming very important to the Green economy development as well as it contributes 12 percent of greenhouse gases. Rapid increase of vehicle amount, decline in global fuel stocks, rise in prices, increase in atmospheric pollution that causes global atmospheric changes related to the ozone holes and global warming, floods in recent decades, force scientists to become very concerned about the problems of transport energy [4,5]. Analysing the global Environment and Energy & Mining Indicators groups it was found that as many as 6 of the same indicators include the Environment group of indicators, as well as the Energy & Mining group of indicators (see Table 1).

Table 1. Environment indicators and energy & mining indicators (developed by the authors according to [7]).

Environment Indicators	*Energy & Mining Indicators*
1) Renewable electricity output (% of total electricity output); 2) Renewable energy consumption (% of total final energy consumption); 3) Energy intensity level of primary energy (MJ/$2011 PPP GDP); 4) Total natural resources rents (% of GDP); 5) Access to electricity (% of population); 6) Access to non-solid fuel (% of population)	
1) Alternative and nuclear energy (% of total energy use); 2) Energy use (kg of oil equivalent per capita); 3) Energy imports, net (% of energy use); 4) Electric power consumption (kWh per capita); 5) Fossil fuel energy consumption (% of total); 6) Fuel exports (% of merchandise exports); 7) GDP per unit of energy use (constant 2011 PPP $ per kg of oil equivalent); 8) Investment in energy with private participation (current US$); 10) Ores and metals exports (% of merchandise exports); 11) Time required to get electricity (days).	1) Renewable internal freshwater resources per capita (cubic meters); 2) Renewable internal freshwater resources, total (billion cubic meters); 3) Agricultural land (% of land area); 4) Surface area (sq. km); 5) PM2.5 air pollution, mean annual exposure (micrograms per cubic meter); 6) PM2.5 air pollution, population exposed to levels exceeding WHO guideline value (% of total); 7) Bird species, threatened; 8) Fish species, threatened; 9) Forest area (% of land area); 10) Forest area (sq. km); 11) Land area (sq. km); 12) Land area where elevation is below 5 meters (% of total land area); 13) Population living in areas where elevation is below 5 meters (% of total population); 14) Population living in slums, (% of urban population); 15) Annual freshwater withdrawals, total (% of internal resources); 16) Annual freshwater withdrawals, total (billion cubic meters); 17) Mammal species, threatened; 18) Adjusted net savings, including particulate emission damage (% of GNI); 19) CO2 emissions (kt); 20) CO2 emissions (metric tons per capita); 21) Arable land (% of land area); 22) Plant species (higher), threatened; 23) Nitrous oxide emissions (thousand metric tons of CO2 equivalent); 24) Methane emissions (kt of CO2 equivalent); 25) Terrestrial and marine protected areas (% of total territorial area); 26) Total greenhouse gas emissions (kt of CO2 equivalent).

Researchers [4] assert, that the energy consumption intensity is one of the environmental challenges in many countries, including the United States. It is important to balance the supply of energy in order to produce safer and cheaper energy, and thereby reduce greenhouse gas emissions. According to the authors, intensive energy consumption contributes to global warming, reduce global growth, and also leads to environmental disaster**.** According to the authors [8], intensive energy

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Green Economy Indicator Analysis of the European Union and Ukraine

One of the key goals of green economy is to match the rich and the poor countries' economic development objectives in order to reduce dependence on the exploitation of natural resources, environmental harm and paving the way for the development of sustainable development principles. There are developing countries in European Region such as Ukraine, which are dependent on natural resources therefore, ecosystem problems, water pollution, droughts, floods, and more frequent storms and other climate-related problems have a huge amount of influence to the economy, and also has a direct connection to poverty [9]. According to scientists [3] energy consumption in the EU countries is growing at higher rates than GDP per capita. But the rising primary and final energy consumption trends, reaching the consumer, may lead to the absolute energy intensity. Absolute energy intensity can disrupt the entire environmental situation, which is not favourable to the EU countries. The results of analysis showed [3] that the energy intensity increases carbon dioxide emissions, and economic growth is the main factor of CO2 emissions. Therefore, the transition to the green economy depends on each state natural and human resources, and the level of development. The main policy objectives of the countries are determined on this, so it is very important to analyse the realization of green economy across the European region. Tables 2 and 3 show what are the main differences of sustainable development and green economy indicators between the 28 EU countries and Ukraine.

Table 2. Environment indicators and energy & mining indicators in the EU and Ukraine*
(developed by the authors according to [7]).

Environment Indicators and Energy & Mining Indicators											
	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Renewable electricity output (% of total electricity output)											
EU	13.87	13.97	14.53	15.40	16.75	18.66	20.34	20.74	23.51	n/a	n/a
Ukraine	6.47	6.67	6.69	5.19	6.14	6.98	7.10	5.74	5.66	n/a	n/a
Renewable energy consumption (% of total final energy consumption)											
EU	8.25	8.54	9.14	9.86	10.42	11.70	12.57	13.08	14.14	n/a	n/a
Ukraine	1.19	1.25	1.73	1.52	2.71	2.97	2.88	2.73	2.83	n/a	n/a
Energy intensity level of primary energy (MJ/$2011 PPP GDP)											
EU	4.82	4.73	4.58	4.36	4.31	4.25	4.33	4.11	4.09	n/a	n/a
Ukraine	18.05	17.45	15.63	14.49	13.89	13.86	15.38	13.98	13.52	n/a	n/a
Total natural resources rents (% of GDP)											
EU	0.587	0.759	0.751	0.708	0.898	0.486	0.595	0.631	0.553	0.533	0.427
Ukraine	11.87	12.22	10.84	12.25	15.51	9.53	13.92	15.47	10.84	9.86	8.13
Access to electricity (% of population)											
EU	n/a	n/a	n/a	n/a	n/a	n/a	100	n/a	100	n/a	n/a
Ukraine	n/a	n/a	n/a	n/a	n/a	n/a	99,8	n/a	100	n/a	n/a
Access to non-solid fuel (% of population)											
EU	n/a	n/a	n/a	n/a	n/a	n/a	98.51	n/a	98.63	n/a	n/a
Ukraine	n/a	n/a	n/a	n/a	n/a	n/a	95.21	n/a	96.02	n/a	n/a
Environment Indicators											
	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Total greenhouse gas emissions (mln. kt of CO2 equivalent)											
EU	5.21	5.18	5.19	5.13	5.06	4.77	4.86	4.73	4.70	n/a	n/a
Ukraine	0.457	0.435	0.433	0.444	0.437	0.367	0.393	0.410	0.405	n/a	n/a
Renewable internal freshwater resources, total (billion cubic meters)											
EU	n/a	n/a	n/a	1504.5	n/a	n/a	n/a	n/a	1504.5	n/a	1504.5
Ukraine	n/a	n/a	n/a	55.1	n/a	n/a	n/a	n/a	55.1	n/a	55.1

*2015 no data available.

Renewable electricity is regarded as the share of electricity generated by renewable power plants in total electricity generated by all types of plants. Renewable energy consumption is considered to be part of the share of renewable energy in total final energy consumption. Energy intensity level of primary energy is regarded as the ratio between energy supply and gross domestic product measured at purchasing power parity. Energy intensity is an indication of how much energy is used to produce one unit of economic output. Lower ratio indicates that less energy is used to produce one unit of output. Total natural resources rents are considered as the sum of oil rents, natural gas rents, coal rents (hard and soft), mineral rents, and forest rents. Access to electricity is calculated as the percentage of population with access to electricity. Electrification data are collected from industry, national surveys and international sources. Access to non-solid fuel is calculated as the percentage of population with access to non-solid fuel. It is interesting to note that both of these indicators analysis is poor, because the period of 2004-2015, the data was submitted only in 2010 and 2012. However, Access to Electricity indicator in year1990 made 99.99 % of population in the European Union and in Ukraine -93.42%; in 2000 – EU- 100 %, and Ukraine – 96.26 %. And Access to Non-Solid Fuel Indicator in 1990, made 95.85% of population in the EU, and in Ukraine only 81.19%; in 2000 - EU -97.54%, and in Ukraine - 90.57% [7]. Total greenhouse gas emissions in kt of CO2 equivalent are composed of CO2 totals excluding short-cycle biomass burning (such as agricultural waste burning and Savannah burning) but including other biomass burning (such as forest fires, post-burn decay, peat fires and decay of drained peatlands), all anthropogenic CH4 sources, N2O sources and F-gases (HFCs, PFCs and SF6). Renewable internal freshwater resources flows refer to internal renewable resources (internal river flows and groundwater from rainfall) in the country. According to scientists [10], it is necessary to devote financial resources to high return investment projects that promote economic growth and, in turn, raise the demand of energy consumption and energy saving policies should be used only in the long term. In the short term the government should encourage investment into scientific researches and development in order to create a new energy-saving technology and involve the financial sector, thus meeting the growing demand for energy.

Table 3. Science & technology indicators (developed by the authors according to [7]).

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
High-technology exports (current bill.US$)												
EU	5.01	5.49	6.27	5.56	5.84	5.04	5.75	6.52	6.41	6.74	6.90	5.49
Ukraine	0.015	0.009	0.010	0.013	0.016	0.014	0.014	0.019	0.026	0.022	0.019	n/a
High-technology exports (% of manufactured exports)												
EU	17.8	18.2	18.6	14.1	13.7	15.2	15.4	14.9	15.5	15.6	15.4	16.2
Ukraine	6.3	3.7	3.4	3.7	3.3	5.6	4.3	4.4	6.3	5.9	6.5	n/a
Research and development (R&D) expenditure (% of GDP)												
EU	1.763	1.756	1.777	1.779	1.848	1.938	1.930	1.970	2.01	2.02	n/a	n/a
Ukraine	1.08	1.167	0.949	0.853	0.846	0.856	0.831	0.738	0.752	0.762	n/a	n/a

According to [11], investment in research and development would not only lead to economic growth, but would also increase competitiveness. It is important to make good use of scientific researches results that were obtained from introduction of innovations, so that they were turned into the appropriate processes and marketed products that would reduce the negative impact on the environment. Two high-technology exports indicators were selected to reveal the EU and Ukraine development of technologies which are calculated as products with high R & D intensity, such as in aerospace, computers, pharmaceuticals, scientific instruments, and electrical machinery. One indicator is calculated by current billion US $, and the other - by percent of manufactured exports. Expenditure for research and development are current and capital expenditures (both public and private) on creative work undertaken systematically to increase knowledge, including knowledge of humanity, culture, and society, and the use of knowledge for new applications. R & D covers basic research, applied research, and experimental development. This indicator is calculated as a percentage

of GDP. The analysed European Union countries and Ukraine‘s both Environment and Energy & Mining and Science & Technology Indicators are significantly different, indicating that Ukraine stands out as a country which, for the implementation of the green economy, will require major efforts to implement political reforms and regulatory changes.

Summary

Green economy is characterized by low greenhouse gas emissions, high resource utilization efficiency and social inclusion, with emphasis on the fact that the well-being must be combined with sustainable use of environmental resources. Income growth and jobs are created by investing new technologies in greenhouse gas emissions and pollution reduction, energy and resource use efficiency, preservation of biodiversity and ecosystem services. Therefore, the aim to develop green economy strategies, are important not only in developed but also in developing countries of the European region, identifying and analysing the environment, energy and technology indicators.

It is likely that all European countries, including Ukraine, will inevitably begin to reduce greenhouse gas emissions and will harmonize economy with ecological needs. In conclusion, it is possible to state that sustainable development problem is being raised and it is being discussed globally, scientists agree with the unanimous opinion that future economic growth is not possible, if the world does not move to the concept of sustainable development and its application.

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