

**CLIMATE CHANGE: THE MAJOR THREAT OF THE 21ST CENTURY**

*We consider important aspects of Kyiv climate change because of natural influences (growing population and level of household consumption accompanied with mounting volumes of waste) and anthropogenic factors (shrinking forests and green spaces, inefficient use of natural resources, increased use of fossil fuels, uneconomical use of energy and water for production and business activities, outdated production technology). The study exposes major negative effects of the climate change, examines the dynamics of trends and the relationship among population growth, consumption of energy resources, emissions of substances to air and waste production in Kyiv during 2000-2013. The environmental conditions in the city are under careful examination and compared with the environmental situation in the largest European capitals. The key scientific and methodological, organizational, economic, technological steps are outlined in the context of Ukraine's integration into the European economic space to counteract climate change in Kyiv.*

**Keywords:** climate change, ecosystem, air, emissions of substances, greenhouse gases, waste, climate control.

General statement of the problem and its relation to important scientific and practical tasks. Climate change is considered to be the greatest threat to nature and humanity in the twenty-first century. We share the warning made by US Secretary of State John Kerry who called climate change perhaps "the world's most fearsome weapon of mass destruction" and said that it was compelling us to act." [1] The experts assume the average global temperatures to increase by 1.4-6.4°C by the end of the 21st century and that may result in a sharp rise of the sea level, alteration of the rainfall distribution pattern, occurrence of floods and drought, leading to a decline in agricultural production, reduction in crop yields and livestock productivity, and as a result to food shortage. A particularly critical situation may develop in Asia, Africa and Latin America [1]. It threatens extinction and disappearance of more than 25% of rare animal and plant species, and may enhance migration processes. According to UN estimates, in 2008 20 million people were migrants due to climate change, and by 2050 these can be almost ten times more [2], which will exceed the current total number of migrants worldwide [3]. Annual losses because of warming could be expected to reach almost 5% of GDP [4].

Climate change becomes important for Ukraine in connection with its transition to the declared stable (sustainable) development and because of adoption of the Law of Ukraine "On the Fundamental Principles (Strategy) of Ukraine's State Environmental Policy for the Period until 2020," "Energy Strategy of Ukraine till 2030 year." Over the past decade there has been a growing intensity of climate change with anthropogenic and human impacts on environment, economy, welfare, and living. This appears especially true in highly urbanized areas, large cities, large industrial centers with heavy traffic flows, intensive use of natural and other resources, accumulation of waste. A nexus is obvious: the cities influence its environment leading to climate change and similarly the climate change affects the cities' economic, social and ecological systems and standard of living. Any failure to realize importance of these processes and a necessity for efficient management of them threatens the food and environmental security, public health, impedes the implementation of the principles and conditions for sustainable development. The Law of Ukraine "On the Fundamental Principles (Strategy) of Ukraine's State Environmental Policy for the Period until 2020" claims the second strategic goal (after raising public environmental awareness) an improvement of the environmental safety. One of the important tasks is to develop by 2015 the "basic principles of national policy on climate change adaptation, development and phased implementation of a national action plan on climate change mitigation

and prevention of anthropogenic impact on climate change for the period until 2030, including the steps within the mechanism of the Kyoto Protocol to the framework Convention of the United Nations on climate Change and joint implementation projects and projects of the environmental (green) investments" [5].

The analysis of recent research and publications on the issue in question. The crucial issues of climate change has been attracting attention of many renowned scholars. Among the latest research on the formation of an effective environmental policy in terms of possible climate change are comprehensive scientific developments accomplished by O.O. Veklich, S.M. Voloshin, L.V. Zharov, E.V. Khlobystov and other researchers. V.G. Potapenko examined the development of "green" economy and aspects of adaptation to climate change in the context of Ukraine's economic security. S.I. Snizhko and O.G. Shevchenko prepared a study into geographical features and urban-meteorological aspects of air pollution in cities [6-8].

Unresolved parts of the problem the paper deals with. Despite significant research portfolio, dynamics, trends of climate change still require an adequate study; the natural and anthropogenic factors influencing this process, especially in urban areas and major cities like Kyiv are not clearly defined. Comprehensive assessment of the Kyiv environmental condition with the use of internationally recognized social, economic and environmental indicators and criteria has not been done yet and its comparison with leading European capitals is still pending. The priorities of actions to mitigate the Kyiv climate change or strategies to cope with the climatic negative effects require continuous research and scientific reasoning.

Statement of the paper goals.

*The aim* of the paper is to identify the key scientific and methodological, organizational, economic, practical actions to prevent climate change and provide adaptation to the climate change by taking into account the socio-economic development of Kyiv.

To achieve the goal, the following objectives were set:

- identify the adverse effects of climate change and the factors influencing the process.
- assess the environmental situation in Kyiv compliant with the universally recognized international parameters of environmental performance, environmental well-being from the standpoint of sustainable development and to show its ranking among European cities.

- formulate proposals to prevent or eliminate the negative effects of climate change in the city of Kyiv taking into consideration the European integration course of Ukraine.

The object of the study is climate change in the city of Kyiv.

A detailed account of the research with a discussion of its findings. The study ascertained that the impact of climate change affected many aspects of life of individuals and society as a whole, specifically the state of ecosystems, quality of life, financial, material and labor costs. Among some of the possible negative effects of climate change we need to consider the ecosystem destruction, extinction of animal and plant species; an increase in frequency and intensity of natural disasters, industrial accidents, deterioration in the quality of life and reduction in life expectancy (Fig. 1).

Climate change and its adverse effects are especially evident as regards the increasing level of urbanization, the concentration of urban population, the production of goods and services in urban areas. Climate change and global warming affect mostly the metropolitan areas, because of the concentration of substances in emissions and discharges and especially due to the greenhouse gas emissions from mobile and stationary sources, from the landfills

overloaded with the accumulated unprocessed wastes, and because of the heat emissions rising in the air from buildings and structures. UN-Habitat's Global Report on Human Settlements 2011 *Cities and Climate Change* alleges that the contribution of the greenhouse gas emissions from human activities has the greatest impact on climate change. The share can constitute from 40 to 70 percent of the emissions estimated on the base of the production data (totaling the greenhouse gas from the facilities located in the cities.) If the estimate is based on the consumption database (totaling the greenhouse gas released at production of the products and services consumed by urban residents regardless of the location of the production sites), the amount of the greenhouse gas share can be as high as 60-70% [2, p. 3]. This is due to the use of extractive fuels (mainly coal, oil, gas) to generate electricity, energy at the public utilities, manufacture, transport, waste recycling at landfills.

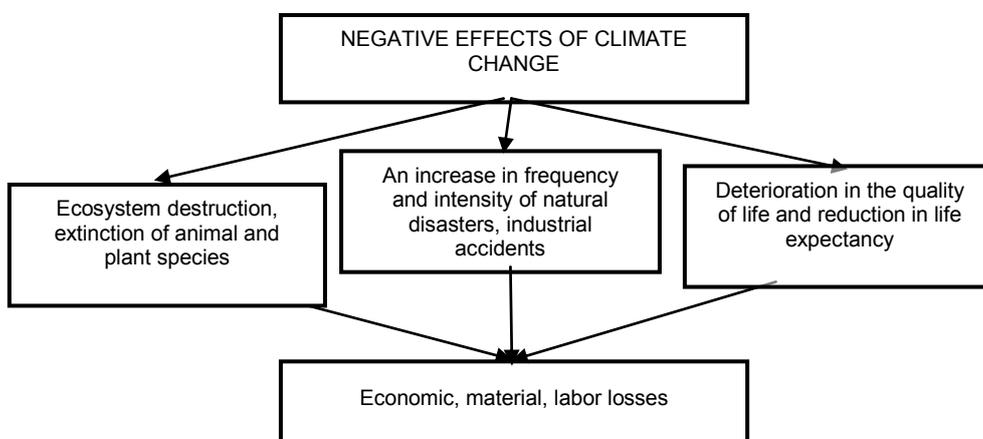


Fig. 1. Major negative effects of climate change

Source: compiled by the authors.

The above trends are universal for all countries, including Ukraine. The statistics of the USSR and Ukrainian censuses show that from 1926 to 2014 the number of urban

dwellers has grown from 5 373 600 to 31 378 600 or by 26 005 000 people that is 5.8 times as much, and their share increased from 18.5% to 69.0%, or by 50.5% (Table 1.)

Table 1. Population in Ukraine and a share of urban dwellers from 1926 to 2014

Year	The entire population (thousand people)	Ratio		The entire population (%)	Ratio	
		Urban	Rural		Urban	Rural
1926	29018.2	5373.6	23644.6	100.0	18.5	81.5
1939	30946.2	11190.4	19755.8	100.0	36.2	63.8
1959	41869.0	19147.4	22721.6	100.0	45.7	54.3
1970	47126.5	25688.6	21437.9	100.0	54.5	45.5
1979	49609.3	30168.9	19440.4	100.0	60.8	39.2
1989	51452.0	34297.2	17154.8	100.0	66.7	33.3
2001	48457.0	32574.0	15883.0	100.0	67.2	32.8
2014*	45553.0	31378.6	14174.4	100.0	69.0	31.0
2014 as regards 1926, %; +,- percentage points (pp)	157.0	5.8 times greater	59.9	X	+50.5 pp	-50.5 pp

\* As of 1 January 2014

Source: compiled by the authors from statistics of the USSR and Ukrainian censuses (1939-2001) and the data of the State Statistics Service of Ukraine [9-11.]

Kyiv climate changes because of natural influences (growing population, increasing level of household consumption, mounting volumes of waste, etc.) and anthropogenic factors (shrinking forests and green spaces, inefficient use of natural resources, increased use of fossil fuels, uneconomical use of energy and water for production and business activities, outdated production technology, low level public environmental awareness) – see in detail [12,13.]

The city of Kyiv is one of Europe's largest natural landscape, business, financial, commercial and industrial centers. One can observe a rapidly swelling number of its residents with the increasing industrial production and transportation in the city. There is an excessive consumption of

energy and other resources with disproportionate accumulation of domestic and industrial waste. In 1927 there were 494 thousand people in Kyiv while in May 2014 the capital's population reached 2.87 million of residents. It is an increment of 2.117 million city dwellers. In other words, the capital's population increased 5.8 times. Power over-consuming production and energy uneconomical households are characteristic features of Kyiv. The consumption of fuel and energy resources are increasing from year to year, and with them emissions of substances to provoke increased temperature and change of climate. Some researchers as S.I. Snizhko, A.G. Shevchenko think that these emissions are harmful [14, p. 20.] See: Table 2.

**Table 2. The dynamics of population growth and consumption of certain types of energy resources and of waste generation in Kyiv from 2000 to 2013**

	2000	2005	2010	2013	2013 vs 2000 (%)
Overall city dwellers (at the beginning of the year), thousand of people	2631.9	2666.4	2785.1	2845.0	108.1
Consumption of energy materials and oil processing products:					
coal (thousand tones)	180.6	185.4	319.1	464.6	257.3
natural gas, mln. m <sup>3</sup>	3910.1	4641.5	4534.0	4072.3	104.1
gasoline engine (thousand tones) <sup>1/</sup>	154.5	296.0	550.4	458.6	296.8
gas oil (diesel fuel, thousand tones)	143.3	227.3	340.1	361.3	252.1
liquefied propane and butane (thousand tones)	1.9	5.7	16.5	45.7	24.1 times greater
firewood for heating (thousand m <sup>3</sup> )	39.1	40.7	47.4	30.2	77.2
Energy consumption (million KWh)	2852.7	3887.4	3710.4	4193.7	147.0
Emissions into the atmosphere (thousand tones)	170.4	220.5	265.3	247.7	145.4
including:					
stationary sources	32.6	33.6	28.6	31.9	97.9
mobile sources <sup>2/</sup>	137.8	186.9	236.7	215.8	156.6
Emissions of carbon dioxide:	...	7.9	9.7	9.2	116.5 <sup>3/</sup>
including:					
stationary sources	...	7.9	7.0	6.5	82.3
mobile sources <sup>2/</sup>	...	...	2.7	2.7	100.0 <sup>4/</sup>
Waste (thousand tones at the end of the year)	171.4	3.1	3553.8	10038.4	2.9 times bigger <sup>3/</sup>

## Notes:

<sup>1/</sup> Excluding sales to public through filling stations.

<sup>2/</sup> 1990-2002 data refer to road transport; the data starting from 2003 refer to the road, rail, aviation, and water transport; the data starting from 2007 refer to the road, rail, aviation, water transport and production facilities.

<sup>3/</sup> 2013 vs 2005 (%)

<sup>4/</sup> 2013 vs 2010 (%). Taking into account that the State Statistics Service of Ukraine changed its technique for assessing the volume and composition of waste, the data of 2000 vs 2005 are not comparable and not considered.

The source: compiled by the authors from statistics [15-18.]

In 2013 the population of Kyiv increased by 8.1% as compared to 2000 and that was accompanied with growth of used: coal 2.6 times for production and communal needs (including coal sales to the households and allowing for the coal losses at production, transportation, distribution and storage), gasoline engine almost 3 times, diesel fuel 2.5 times, liquefied propane and butane 24.1 times, power 1.5 times. During this period, emissions into the atmosphere especially those from the mobile sources increased nearly half as much again (56.6%). A similar trend is observed with regard to waste. The volume of waste in 2013 as compared to that in 2010 increased from 3553.8 to 10.0384 million tons, or 2.9 times. All this proves inefficient, ineffective use of non-renewable resources, and operation of resource-intensive economy.

The increasing concentration of substances released into the air, in addition to greenhouse gases and heat cause warming and intensify extreme natural (weather) events and enhances the pressure on the environment, people, flora and fauna. Green areas of cities and of residential suburbs

are incapable of "neutralizing" completely the negative impact of the human activity. The result is an imbalance of the ecosystem accompanied with social and economic losses. According to the World Health Organization, each year an average of 27 thousand people die in the cities of Ukraine due to diseases caused by dusty air [19, c. 20].

Although Ukraine is among the countries that have an average level of moderate sensitivity to climate change (the 75th position among 123 countries), nevertheless *Maplecroft*, which is the world's leading global risk analytics, research and strategic forecasting company, ranks Kyiv by its environmental status as one of the critical places in Europe. Kyiv is on the last 30th position by the index of environmental performance that reflects the individual indicators of the environment in urban areas (CO<sub>2</sub> emissions, clean air and water, waste, condition of housing, energy consumption, transport and environmental governance.) The index of environmental performance of the capital of Ukraine was only 32.33% in 2010. This index is almost three times lower than that of other European countries (Table 3).

**Table 3. Green city index in 2010 (%)**

Rank	City	Green City Index	Rank	City	Green City Index
1	Copenhagen	87.31	16.	Warsaw	59.04
2	Stockholm	86.65	17	Budapest	57.55
3	Oslo	83.98	18	Lisbon	57.25
4	Vienna	83.34	19	Ljubljana	56.39
5	Amsterdam	83.03	20	Bratislava	56.09
6	Zurich	82.31	21	Dublin	53.98
7	Helsinki	79.29	22	Athens	53.09
8	Berlin	79.01	23	Tallinn	52.98
9	Brussels	78.01	24	Prague	49.78
10	Paris	73.21	25	Istanbul	45.20
11	London	71.56	26	Zagreb	42.36
12	Madrid	67.08	27	Belgrade	40.03
13	Vilnius	62.77	28	Bucharest	39.14
14	Rome	62.58	29	Sofia	36.85
15	Riga	59.57	30	Kyiv	32.33

The source: compiled by the authors from data [20]

Kyiv is in last place among the top 30 European cities in terms of environmental performance from the standpoint of sustainability. This is because of an extremely inefficient use of resources, technological backwardness,

low levels of corporate social and environmental responsibility of business, culture and environmental awareness of citizens, etc. (Table. 4).

**Table 4.** Index of environmental performance of Kyiv in its sustainability among 30 cities of Europe in 2009

	Kyiv	Copenhagen	Stockholm	Helsinki	Berlin	London	Istanbul	Moscow
Population, mln.	2.7	0.5	0.8	0.6	3.4	7.6	12.6	10.5
GDP per capita, thousand. Euros	5.0	43.6	39.4	52.8	21.6	44.9	14.6	14.5
Annual greenhouse emissions per head (CO <sub>2</sub> -equivalent, tones)	4.1	5.4	3.6	6.0	6.6	5.8	3.3	6.4
Energy consumption per head	87.2	80.6	104.9	88.6	77.7	78.0	36.2	117.2
Percentage of renewable energy consumed by the city	0.5	18.8	20.1	3.5	1.8	1.2	5.1	н/д
Total percentage of citizens walking, cycling or taking public transport to work	89.0	68.0	93.0	44.7	54.8	63.0	54.0	н/д
Annual water consumption per head m <sup>3</sup>	265.6	147.0	185.8	76.3	55.6	57.6	68.6	143.9 (157.5) (164.2)
Share of waste recycled (%)	0.0	23.6	31.0	57.6	35.0	20.0	3.1	15
Rank	30	1	2	7	8	11	25	n/a

The source: compiled by the authors from data [21]

As one can see from Table 4 the city has a low share (0.5%) of energy production from renewable sources and virtually no domestic waste processed (less than 1%). At the same time, other European capitals demonstrate much better these two indices: Copenhagen: 18.8 and 23.6%, Stockholm: 20.1 and 31.1%, correspondingly. Kyiv has an excessively high per head water consumption: 265.6 m<sup>3</sup>. For comparison, the index of water consumption in some other cities: Copenhagen 147.0 m<sup>3</sup>, Stockholm 185.8 m<sup>3</sup>, Helsinki 76.3 m<sup>3</sup>, and Berlin 55.6 m<sup>3</sup>.

Transparency of atmospheric air has a significant effect on climate change and ecological state of the city. The air transparency is being deteriorated due to emissions of substances from stationary and mobile sources, which are the transport and energy sectors, as well as from the waste management. Greenhouse gases that are released into the atmosphere augment the greenhouse effect, keeping the sun's heat in the lower atmosphere. Today, Ukraine is among the top twenty countries that emit the most greenhouse gases in the atmosphere. The Kyoto Protocol, signed by Ukraine in 1999 does impose certain environmental obligations on the country, though regrettably, not rigid enough. It does not require an attenuation of greenhouse gas emissions as it allows fixing the releases at the level of 1990 indicators. In this case, there is a possibility even to increase the emissions into air.

Air quality in Kyiv depends primarily on emissions of pollutants from stationary sources (production companies, facilities, installations, etc.) and mobile sources (engines of the aviation, railway, and water transport and of the industrial units.) Thus, according to the Central Statistical Office, in 2013 the stationary and mobile sources of emissions released 247,700 tons of materials and, in addition, 9.2 million tons of carbon dioxide into the atmosphere of Kyiv. From year to year the density of emissions increases and is greater than 300 tons per square kilometer, which is almost 30 times higher than the average for Ukraine. The main sources of emissions are motor vehicles of the road transport. In 2013, in Kyiv, emissions from these sources accounted for 215,800 tons of carbon dioxide and 2,700 tons, or 87.1% and 29.3% of the total emissions. In recent years, emissions are growing, especially due to the contribution from road transport.

Due to the increase of amount and concentration of emissions in the air its temperature grows, the number of extreme weather events becomes greater (hot weather, droughts, floods, landslides, hurricanes, etc.). According to

the Ukrainian Hydrometeorological Center, for the last 20 years the average temperature in January and February has increased by nearly 2.5 degrees. The Center reports that the last decade was the warmest in history of meteorological observations. The probability of the summer temperature of 30 degrees or greater has also increased significantly [22].

To avert climate change and mitigate its negative effects, Kyiv undertakes certain scientific, methodological, technological, organizational and investment activities. In accordance with the decree of the executive body of the Kyiv City Council (Kyiv City State Administration) "On ensuring the 2013 environmental activities in Kyiv", in June 2013 the scientists of the Economic Faculty of the Taras Shevchenko Kyiv National University organized the international conference on prevention of climate change: "Climate and the City" (Kyiv case study.) Besides, the Kyiv City strategy to avert climate changes and adapt to them been developed in view of the socio-economic development of the Ukrainian capital. The strategy defines the purpose of the basic principles, the main drivers of climate change, the main lines of organizational and economic instruments to avert climate changes and adapt to them, taking into account the characteristics and prospects of development of the city until 2025. The legal, economic and organizational activities focus on the most energy consuming and energy intensive sectors of municipal services with the purpose to avert climate change in Kyiv for mitigation and adapt to the climate alterations that have already occurred.

More than 70 cities of Ukraine joined the EU initiative "Covenant of Mayors", which is implemented in eleven countries of the Eastern Partnership and Central Asia, and signed it in order to develop an effective energy-saving policy, including a reduction of 20% of the consumption of fossil fuels and reduce CO<sub>2</sub> emissions into the atmosphere in 2020, cut down the share of the city budget allocated for the purchase of energy. Currently the use of heat per square meter in Ukraine is 2-3 times higher than in the EU. The actual consumption of energy is twice as large as the need for it [23].

Based on the experience of foreign countries, Kyiv takes steps towards operation of electric transport vehicles, in particular of electric cars in the city. The world's largest fleet of electric taxi is expected to be in China in 2022. Thus, Shenzhen plans to operate 1,200 buses and 800 taxis equipped with electric motors. According to "BIO Avtomotiv", the company that imports electric vehicles to Ukraine, there are only 130 electric vehicles in the country.

They are environmentally friendly and this is their main advantage compared to those that run on gasoline, though the disadvantages are a long process of the battery recharging, a low speed (typically 70-80 km per hour), and costly batteries with a limited lifetime of 5-7 years. Thus, the cost of the battery can be up to 50% of the overall cost of a 120-180 thousand hryvnia electric car. In addition, the necessary infrastructure for servicing electric vehicles has not been created yet. Despite these and other problems, Kyiv has launched a privately invested project of setting up a taxi company of electric cars. The investment is expected to be paid back in 2-2.5 years. Ten electric charging stations (for ten cars each) are to be arranged in different areas of the city. Electric cars will charge their batteries in 20 minutes. One of these electric charging stations has been in operation in Heroes of Stalingrad of Obolon district street since 2012. The electric vehicles are to be equipped with lithium-iron-phosphate batteries, which with a single charge will provide 150 mileage [24].

Kyiv undertakes measures to reduce the impact of its combined heat power plants (CHPP) on the environment. Thus, the city modernized equipment, introduced a modern energy-saving technologies and equipment for use of natural gas, which is considered to be main environmentally-friendly fuel for CHPP-5 and CHPP-6 that generate heat and electricity for Golosiivsi, Pechersk and Darnitskii (CHPP-5), Obolon, Desna, Dnieper, Podolsky, Shevchenko (CHPP-6) districts of Kyiv. The total capacity of these power plants is 1200 MW, the thermal power is 3614 Gcal / h, and the impact on the environment meets current national and global environmental standards.

The megapolis implements projects aimed at processing hard domestic wastes, which is a source of greenhouse gases in the atmosphere. Clean City national project started came in force in 2010. The City Council approved the Program of municipal waste management for 2010 – 2015. This program comprises construction of five waste processing facilities. A modern waste processing complex with capacity of 65 thousand tons of waste per year started to work in April 2013. It provides recycling and waste delivered from Darnitskii and Obolon districts. However, in recent months the implementation of the planned measures has been suspended due to lack of funding.

In general, the above and other measures to combat climate change are inadequate. According to the Climate Change Performance Index Ukraine moved from the 19th to 35th place surrender its place even India, whose economy exerts one of the greatest world's impact on climate change [25]. Ukraine should create an effective integrated policy to avoid climate change and adapt to climate alterations, actively undertake actions to reduce greenhouse gas emissions, lessen energy intensity of production, and increase use of renewable energy sources, and to ratify amendments to the Kyoto Protocol.

It is expedient to design and implement the national and Kyiv programmes of averting climate change and its adverse effects. One should remember that many of the capitals and cities of the developed countries for example Amsterdam, Berlin, Boston, Vancouver, Hamburg, Hong Kong, Cape Town, London, New York, Paris, Rotterdam, Seattle, Singapore, Toronto and Ho Chi Minh and others have adopted and successfully implement concepts, strategies, programmes of counteracting climate change and providing adaptation to climate alteration.

In designing and implementing the programmes of socio-economic development of Ukraine and other documents one must take into account the risks associated with climate change, defining the tasks in lessening human impact on climate and adapting to climate change. The results of comprehensive studies into weather and climate should be the basis for the programmes to ensure assess-

ment and forecast of the risks and benefits to the economy from climate change, resources to adapt to these changes, as well as threats to national security.

The time has come to define the criteria, parameters (thresholds) conditions of security for the economy and population of Ukraine, the major cities, including Kyiv under climate change. It concerns the indicators of health status, mortality, living conditions, extreme weather events (drought, overwetting), disturbing the environmental balance, the spread of infectious and parasitic diseases, the increase in electricity consumption for cooling the air in summer, etc.

It is essential to develop and implement multisectoral strategies and policies to lessen greenhouse gas emissions by introducing economic mechanisms and levers to reduce the emissions, primarily in industry, energy and transport, and encourage use of renewable energy for production of heat and electricity.

For implementation of Ukraine's course towards European integration, special attention should be paid to the modernization of housing and communal services to curb greenhouse gas emissions and heat into the atmosphere, reduce excessive consumption of the heat, energy, water, waste generation at operation of buildings and structures running households. This will be contributed by the following:

- introduction of a clear transparent system of accounting energy consumption in flats and buildings by equipping them with devices to record consumed water, heat, electricity, and natural gas,
- implementation of an energy management system, preparation of energy certificates of buildings,
- planning new compact houses with windows to the south, reducing the area of the glass coating, excluding air flow area, painting the walls a light color,
- thermal insulation of external walls, windows, entrance doors of buildings, installation of solar collectors on the roofs, updated plumbing, sewer, electrical, ventilation networks, etc.,
- planning construction of streets with an account for prevailing wind direction for optimum wind regime of the city, the cooling of buildings, construction of industrial and residential areas.

Attention should be drawn to the current EU stringent requirements for its members to fulfill their commitments on energy efficiency of buildings. The European Commission summons Poland and Austria to the Court of Justice of the European Union for failure to fulfill obligations to implement the EU Energy Performance of Buildings Directive (EPBD.) In case of a condemnatory judgement, the countries may face daily fines: Poland over 96700 euros; Austria almost 39 600 euros. According to EU requirements each of the EU members must approve the standards of minimum requirements for the energy performance of buildings, create a system of certification and organize regular inspections of heating systems and air-conditioning [26].

Because of the reduction of green area in Kyiv and its suburbs it is necessary to develop and implement a concept, and then a program of arranging green spaces in the city for its adaptation to climate change. Particular attention should be given to the development of organizational-economic mechanism for the implementation of these strategies. Presently there is about 16 m<sup>2</sup> of green space per one Kyiv resident, while, the international standards requires 25 m<sup>2</sup>, which is 1.6 times more [27].

It is essential to strengthen and develop the information base and provide the city residents and wide public an access to information on climate change, its impact on health, human life and society, the benefits of energy conservation and the necessity to achieve it, improve utilization of renewable energy sources, the use of energy-saving technologies and the like.

The conclusions from this study and an insight into further research in this field.

In order to prevent the negative effects of climate change in Kyiv, avert climatic alterations or adapt to them it is necessary to strengthen and develop the socio-economic, environmental and information policy on formation of the climatic eco-friendly environment. Such a policy should comprise a set of measures to develop the city's programme of prevention of climate change and adaptation to climate alterations, the programme of arranging green spaces in the city for its adaptation to climate change, the modernization of housing and communal services, buildings and structures, the arranging of the effective transport and logistics systems, the creation of green areas, the implementation of clean and resource-saving technologies, the use of renewable energy sources and the increasing public awareness of climate change issues. Implementation of these and other strategies will contribute to making Kyiv's environment closer to meeting the requirements and standards of the EU in the field of sustainable development, and in forming of a modern system to manage climate change in urban areas.

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## SYSTEM PRINCIPLES OF THE SOCIALLY RESPONSIBLE INVESTING OF POWER PROJECTS OF UKRAINE

*The new direction of modern investment projects was researched – socially responsible investing. We consider the system principles of social investment, including the selection of the best options for risk analysis, assessment and minimization. The methods of estimation of social projects in the energy sector of Ukraine for every type of risk were examined. The expert estimation of three power projects was analysed. The regressive model of estimation of competence of every expert was built and the type of projects according to environmental and social principles of analysis has been established.*

**Keywords:** socially responsible investment, investment risk, responsible investment principles, strategies of modernization, investment projects, regression analysis.

**Introduction.** Modern society characterized by the new level of economic and social development. Recently, socially responsible investment (SRI) have increased significantly in popularity among investors worldwide. SRI investors combine financial objectives with their desire to contribute to the solution of social, ethical and environmental issues. Today the successful operation and development industry are largely dependent on the level of social responsibility.

Objective justification for the need of socially responsible development strategy requires proper study of the problem of social investment risks.

The market of social investment is relatively new ([1, 2], 2011). Risks relating to social investment opportunities may be uncertain, they are usually difficult to assess. In-

vestors should carefully weigh the risks associated with investing in the social sphere, as they currently have a low level of regulation compared to other investments.

Despite the increasing urgency of the problem of social and investment activities in theory and practice prevails fragmentary analysis and selective approach to certain aspects of the coverage, including an approach to the study of social investment risks. As a result of particular relevance to the issues of building an integrated system of socially responsible investing, including the identification of risks and the selection of the best options for their analysis, evaluation and minimization.

In the classic sense, "social investment" – a long-term investment of financial resources in the social facilities to