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**GREEN CONSTRUCTION AS THE PRIORITY DIRECTION
OF GREEN ECONOMY FORMATION**

Abstract. The essence, characteristics and advantages of the green economy are considered. The feasibility of the transition of our country's economy to a green economy is justified. Green construction is justified as a priority direction of Ukraine's green economy formation. The technologies of green construction have been studied. The advantages of green technologies used in construction are explored. The world standards of green construction are considered. The social, economic and environmental benefits of the categories "green economic growth", "green economy" and "sustainable development" have been analyzed. The economic effect of green technologies implementation is shown. The features of the transition to a green economy are studied. Comparison of green construction promotion measures in different countries is represented. As the methodological support for the transition to a green economy is suggested turning to the basics of the integrated development model, considering constantly changing environmental conditions.

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Key words: green construction, green construction benefits, green technologies, green economic growth, green economy formation, sustainable development, national economy.

Introduction. The role of the construction complex in modern conditions is difficult to overestimate because the construction industry is the locomotive of the national economy growth. The importance of this industry for the

country's economy can be explained as follows: capital construction creates a large number of jobs and uses products from many sectors of the national economy. The economic effect of the development of this industry lies in the multiplicative effect of the funds invested in construction. Together with the construction industry development, the production of building materials and related equipment is developing, engineering industry, metallurgy and metalworking, petrochemicals, glass production, woodworking, transport, energy are developing. In addition, construction as no other branch of the economy contributes to the development of small and medium-sized businesses. The development of the construction industry necessarily causes economic growth in the country and the solution to many social problems. Therefore, the transition to green building will become the driver for the development of the green economy.

The question about "green building" has become an actual topic in different researches and there are already many developments. Thus, green building in particular was studied in the works of a lot of Ukrainian and foreign scientists. L. Bourdeau, C. Lockwood, S. Fard, T. Woolley, M. Samer, C. Kibert, J. Sendzimir, G. Guy are among of them.

The problem of Ukraine's transition to the principles of the "green economy" and sustainable development was described in the works of A. Martyniuk, Yu. Ogarenko, E. Prushkivska, Yu. Shevchenko, V. Potapenko, V. Pidlisniuk, M. Zagirnyak, E. Yerkova, O. Chmir, N. Zakharkevich and other. In addition, many international institutions are involved in the development and implementation of the green economy concept: World Commission on Environment and Development, United Nations Organization, United States Environmental Protection Agency, Danish Organisation for Renewable Energy, International Chamber of Commerce on Environment and Energy.

The goals of sustainable development in Ukraine need to be understood as a new system of mutually agreed management measures for economic, social and environmental protection measures aimed at building public relations on the basis of trust, solidarity, equality of generations and a secure

environment. These goals should ensure the integration of efforts for economic growth, the pursuit of social justice and the rational use of nature, which requires deep socio-economic transformation in Ukraine and new approaches to opportunities for global partnership. In Ukraine, defining the sustainable development goals, it is necessary to take into account the global development benchmarks, the principles of sustainable development and public opinion regarding the vision of future development. Brundtland Commission in 1987 emphasizes that sustainable development is “development that meets the needs of the present without compromising the ability of future generations to meet their own needs”.¹⁰⁴ As international experience shows, social progress depends on maintaining a balance between the goals of supporting economic growth, business competitiveness, environmental security and reducing social inequality¹⁰⁵. In our opinion, one of the goals for achieving sustainable development, which is of prime importance, is ensuring environmental sustainability of cities and towns, which may be provided right by the transition to the green economy.

In order to investigate in detail the role of green construction in the formation of the green economy, it is necessary to begin with analysing the content of these terms.

Green economy as a component of sustainable development means the economy that results in improved human well-being and social equity, reducing environmental risks and ecological problems. It is one of directions to achieve a resilient economy that provides a better quality of life, it is a means to link the economic, environmental and social considerations of sustainable development to achieve a long-term economic development by investing in environmentally friendly and socially equitable solutions^{106, 107}.

¹⁰⁴ Report of the World Commission on Environment and Development: Our Common Future. Available at: <http://www.un-documents.net/our-common-future.pdf>

¹⁰⁵ Bourdeau, L. (2000). Sustainable Construction: A Framework and International Agenda for Change. Int. Council for Research and Innovation in Building and Construction CIB. Publication No. 260

¹⁰⁶ Lockwood C. Building the Green Way // Harvard Business Publishing. (2006). Pp. 129 - 135.

Green economy is a system of economic activity associated with the production, distribution and consumption of goods and services that lead to a rise in human well-being for a long time, while not exposing the future to significant environmental risks or environmental deficit¹⁰⁸.

According to the United Nations Environment Program definition, the green economy is an economy that leads to an increase in the well-being of people and a strengthening of social justice while simultaneously significantly reducing the risks to the environment and the shortage of environmental resources¹⁰⁹.

"The green economy is an economy where economic growth and environmental responsibility work together, reinforcing each other while supporting progress on social development issues" as said in the Report of the Commission of International Chamber of Commerce on Environment and Energy¹¹⁰.

Danish Organisation for Renewable Energy¹¹¹ suggests understanding of the green economy as the process of transformation, which eliminates the dysfunctions of the modern economy, and which results in the well-being of humankind and fair access to resources for each member of society in the conditions of ecological and economic integrity.

The "green economy" is also considered by scientists in the context of reducing carbon emissions, increasing the efficiency of all types of resources, building a system of public interest. The goal of the green economy is to create an effective environment for economic and social progress, based on minimizing the negative impact on the environment and the efficient use of

¹⁰⁷ Martyniuk A., Ogarenko Yu. (2012): Prospects for the development of the "green" economy. Friedrich Ebert Fund, 16 p. Available at: http://www.fes.kiev.ua/new/wb/media/publikationen/green_economy_perspectives.pdf.

¹⁰⁸ Report of the Forum of Ministers of Latin America and the Caribbean. Available at: <http://www.pnuma.org/forodeministros/17-panama>.

¹⁰⁹ Towards a "green" economy: the path to sustainable development and poverty eradication. Full report / United Nations Environment Program (UNEP). (2011). - 739

¹¹⁰ Report of the Commission of International Chamber of Commerce on Environment and Energy (2011): "Ten Conditions for the Transition to the Green Economy" No. 213-18, 7.

¹¹¹ Danish Organisation for Renewable Energy. Available at: <http://www.ove.org>

natural resources while maintaining a decent standard of living for the population¹¹².

As we see, there is no singular definition of "green economy", but within the limits of the definitions above the main directions of transition from the "brown" economy, which at present is the economy of Ukraine to the green economy, are outlined. The main focus is on resources: natural ones, because they are limited, human ones - because in most cases they need improvement of usage conditions and creation of decent living conditions.

Since the green economy, which is being implemented by UNEP, aims to help governments in forming and focusing the policies and processes for investing in green sectors of the economy, including clean technologies, renewable energy, water supply, transport, waste management, green construction. It should be emphasized that green construction will be the driver for all of these industries.

Analyzing the essence of "green construction" we may note the definition of National Agency for Sustainable Development, which defines it as a practice of construction and exploitation of buildings whose goals are reducing the consumption of energy and material resources throughout the life cycle building, preservation or improvement of the quality of buildings and their internal environment comfort¹¹³.

"Green construction" is a system of measures aimed at increasing the efficiency of using natural resources with simultaneously reducing the negative impact of buildings on the environment and human life, throughout building cycle and building maintenance¹¹⁴.

Green construction as the element of green economy means the use of resource-efficient and environmentally responsible processes in construction to ensure lifetime sustainability of the building. Primarily, the sustainability

¹¹² Pidlisniuk V., Zagirnyak M., Yerkova E. (2013): Strategy of Sustainable Development and Climate Change. Kremenchuk: Shcherbatykh Publishing House; O.S. Chmir, N.P. Zakharkovich (2013): "Green" economy: essence, goals and basic principles.

¹¹³ National Agency for Sustainable Development. Available at: <http://green-agency.ru/>

¹¹⁴ Draft Law on Energy Efficiency of Residential and Public Buildings. Available at: http://search.ligazakon.ua/l_doc2.nsf/link1/JF5SR00A.html

context of building implies building operations, site design, maintenance, repair, and demolition with the least harm to the environment. The U.S. EPA says “Green building is the practice of creating structures and using processes that are environmentally responsible and resource-efficient throughout a building’s life-cycle from siting to design, construction, operation, maintenance, renovation and deconstruction. This practice expands and complements the classical building design concerns of economy, utility, durability, and comfort. Green building is also known as a sustainable or high-performance building¹¹⁵”.

The green construction requires close collaboration of the construction engineers, the client and the architects in the entire construction project. The aim is to ensure that building and construction methods are cost-effective, durable and reduce the overall effects on the environment and human health with a central focus on efficient use of energy and resources, water preservation, improved occupational health, and reducing pollution and wastage. Green technology in the construction industry involves producing new buildings that incorporate one or more aspects of environmentally friendly solutions. Green constructing has raised the bar for the housing industry in its entirety by establishing new standards for livability and sustainability. Green construction implies the usage of green technologies, which are different from common technologies used in the standard construction process. The application of green technologies in the construction industry has a high demand in the world. Green technologies allow expanding geography of construction, creating more economically advantageous conditions of operation of buildings, increasing the life of built buildings, and positively affecting the quality of life and health of the population living in green houses. Among them, it is needed to highlight the next technologies¹¹⁶.

First is the solar power, which has been increasingly exploited as a sustainable construction technology. In green construction, it is utilized in

¹¹⁵Green Buildingsat EPA. Available at: <https://www.epa.gov/greeningepa/green-buildings-epa>

¹¹⁶What is Green Construction? // Available at: <https://www.conserve-energy-future.com>

two ways. One pertains to active solar power and the other is passive solar power. Active solar power is the use of functional solar systems that absorb the sun's radiation to cater for heating and electricity provision. It reduces the need for the use of electricity or gas. The upfront installation costs are higher but in the long-term it saves on energy bills and aids in reducing greenhouse gas emissions from non-renewable energy sources like fossil fuels. On the other hand, passive solar power is a design that uses the sun's rays to warm homes through the strategic placement of windows and the use of heat-absorbing surfaces. The windows let in energy and the heat absorbed reduces the need for warming the house during cold periods such as winter.

Biodegradable materials – the next green technology. The usage of biodegradable materials is an eco-friendly means of making construction sustainable. Most traditional construction methods lead to accumulation of waste products and toxic chemicals, majority of which take hundreds of years to degrade. Moreover, even if they degrade, it contaminates and harms the environment. Biodegradable materials such as organic paints therefore aid to limit the negative impacts on the environment as they easily breakdown without the release of toxins. The use of biodegradable materials for building foundation, walls and insulators are also part of sustainable construction technologies.

Green insulation is among the greatest concerns when it comes to construction of buildings and homes. However, most people do not know that insulators are simply wall filters, which do not need to be made from expensive and highly finished materials. On this basis, the use of green insulation has proven to be a sustainable construction technology as it eliminates the need of high-end finishes made from non-renewable materials. Green insulation offers a solution by making use of old and used materials such denim and newspaper. In other words, it utilizes recycled material to line the walls.

The usage of smart appliances in buildings is important part of green construction technologies. Homes and commercial buildings consume most of the world's energy and for this reason, it has necessitated the use of smart

appliances as part of sustainable construction technologies. The sustainable construction technologies emphasize the installation of energy saving and self-sufficient appliances. Smart dishwashers, refrigerators and washing machines are examples of such sustainable technologies. The technology is oriented towards establishing zero-energy homes as well as commercial buildings.

Cool roofs are sustainable green design technologies, which aim at reflecting heat and sunlight away. It aids in keeping homes and buildings at the standard room temperatures by lowering heat absorption and thermal emittance. The design makes use of reflective paints and special tiles which absorb less heat and reflect away most of the solar radiation. For instance, cool roofs can reduce temperatures by more the 50 degrees Celsius during summer. Cool roofs therefore minimize the dependence on air conditioning and in turn, reduce energy use, which translates into decreased cumulative greenhouse gas emissions from power plants.

Sustainable resource sourcing as the name suggests that it is a prime example of sustainable construction technology because it ensures the use of construction materials designed and created from recycled products and must be environmentally friendly. In most cases, agricultural wastes or by-products are used to produce the construction materials. Overall, the materials are remanufactured, recycled, recyclable, and obtained from sustainable sources.

Sustainable construction technologies typically include mechanisms to decrease energy consumption. The construction of buildings with wood, for instance, is a sustainable construction technology because it has a lower embodied energy in comparison to those build of steel or concrete. Sustainable green construction also makes use of designs that cuts back air leakage and allows free flow of air while at the same time using high performance windows and insulation techniques. These techniques are meant to reduce the dependence on air conditioning and interior heating. Further, the strategic placement of windows is another technique that encourages day lighting thereby minimizing the need for electric lighting during the day. The use of renewable energy such as solar for lighting and water heating is also part of a low-energy house and zero-energy building design. The initial costs of

setting up zero-energy buildings may be high, but they pay off in the long-term.

Electronic smart glass also constitutes one of the technologies in sustainable construction. The electronic smart glass is a new technology that works particularly in summer periods to shut out the harsh heat of solar radiation. The smart glass uses tiny electric signals to slightly charge the windows to change the amount of solar radiation it reflects. It is incorporated into the buildings control system therefore allowing the users to choose the amount of solar radiation to block. With this technology, homes and commercial buildings can save a lot on heating, ventilating, and air conditioning costs. The smart glass is still being perfected and is soon set to be fully used in sustainable construction as a smart energy-saving technology.

Talking about water, there are several water efficient technologies used, which are all part of sustainable construction technologies. Essentially, the technologies encompass re-use and application of efficient water supply systems. Examples are usage of dual plumbing, greywater re-use, rainwater harvesting and water conservation fixtures. These methods ensure that water is adequately managed, recycled and used for non-portable purposes like washing cars and flushing toilets. Dual plumbing, for instance, decreases sewer traffic and enhances the potential of re-using water on-site. On the other hand, rainwater harvesting provides water for multi-purpose usage and it might be stored for future use. In general, the water efficiency sustainable construction technologies lower water usage costs and help in water conservation. In urban areas, the technologies intend to lower water wastage by 15% to address fresh water shortages.

The health and safety are fundamental and must be guaranteed during the construction of any building or home. As such, sustainable indoor technologies are mandatory in green construction. The materials used must ensure green safety standards which include hazardous free elements, non-toxic materials, low volatile emissions, and moisture resistance like materials

from cork, wood and bamboo are naturally sourced and do not have any toxic, irritating or carcinogenic elements¹¹⁷.

The advancement to constructing self-powered buildings is an art of sustainable construction technology. The reason is that self-powered buildings bring about the realization of zero-energy construction. The buildings are built so that they are able to generate sufficient power to support their own energy needs and even direct surplus energy back into the power grid. In most cases, wind power technology is used, and it is highly common in skyscrapers whereby wind turbines are mounted at the rooftops. The constant and heavy air currents at higher altitudes propel the turbine blades, which generates the power requirements for the building.

Rammed earth brick is an ancient construction technology, which has lately been re-introduced to cater for the demands of environmental sustainability. The technique uses sustainably sourced raw materials. Due to technological advancements, the process of building a rammed-earth structure has been made easier but it still follows the ancient preparation process. Moist earth mixture and hard substances like gravel or clay are mixed with stabilizing elements such as concrete and compacted to create dense, hard walls. The sourcing and formation process of rammed-earth bricks makes it ideal for sustainable construction as it lessens environmental impacts and the material can equally stabilize the temperature of a building. Rammed-earth structures contribute to fewer emissions and ensure that the buildings remain cool in the summer and warm in the winter¹¹⁸.

The features, which are different in traditional and green construction are shown in the Table 1.

¹¹⁷ Fard S. Post Occupancy Evaluation of Indoor Environmental Quality in Commercial Buildings: Do Green Buildings Have More Satisfied Occupants? [master's thesis] (2006). Berkeley: University of California.

¹¹⁸ Woolley T.(Ed). (2000). Green Building: Establishing Principles. Ethics and the Built Environment. Warwick Fox. Rutledge, London: 44-56.

Table 1. Comparative characteristics of traditional and green construction

Indicators	Green construction	Traditional construction
Energy consumption	low	High
Quality of the environment inside construction	very high	High
Emission level	low	High
Waste management system	high-tech effective	Effective
Building materials	environmentally friendly	environmentally destructive

Source: compiled by the authors on the basis of the source¹¹⁹

The widespread implementation of green technologies in construction industry of Ukraine is impossible without the implementation of green construction standards in the usage of the majority of domestic construction companies as well as foreign companies operating in the country.

If we turn to the recognized world standards of construction, which use green technology, we would like to note the standards of green construction of the US, the experience of which can be applied to our transition to green construction standards (Table 2.).

¹¹⁹ Samer M. (2013): Towards the implementation of the Green Building concept in agricultural buildings: a literature review, Vol. 15. – № 2. – P. 25–46.

Table 2. Green Building Standards

Standard	Building Type	Project Type	Subject Areas
International Code Council's 2012 International Green Construction Code - the model code that contains minimum requirements for increasing the environmental and health performance of buildings, sites and structures. Generally, it applies to the design and construction of all types of buildings except single- and two-family residential structures, multi-family structures with three or fewer stories, and temporary structures.	Commercial: all Industrial: all but manufacturing systems and equipment Mixed use: all Residential: multi-family with more than 3 stories	New construction Additions Alterations	Sustainable sites Energy efficiency Water efficiency Materials and resource use Indoor environmental quality Emissions Operations and maintenance
Standard for the Design of High-Performance Green Buildings Except Low-Rise Residential Buildings – the model code that contains minimum requirements for increasing the environmental and health performance of buildings, sites and structures. Generally, it applies to the design and construction of all types of buildings except single-family homes, multi-family homes with 3 or fewer stories, and modular and mobile homes.	Commercial: all Industrial: all Mixed use: all Residential: multi-family with more than 3 stories	New construction Additions	Sustainable sites Energy efficiency Water efficiency Materials and resource use Indoor environmental quality Construction and operations plans
ICC 700-2012: 2012 National Green Building Standard (ICC 700) - the rating and certification system that aims to encourage increased	Mixed use: residential space	Mixed use: residential space	Mixed use: residential space

environmental and health performance in residences and residential portions of buildings. Its criteria apply to the design and construction of homes and subdivisions.			
Green Globes - the series of rating and certification systems that encourage improved environmental and health performance for all types of buildings except residential structures. Green Globes Trade Mark is administered in the U.S. by the Green Building Initiative.	Commercial: all Mixed use: all Residential: multi-family	New construction Additions Alterations Existing buildings	Sustainable sites Energy efficiency Water efficiency Materials and resource use Indoor environmental quality Emissions Project/environmental management
US Green Building Council's Leadership in Energy and Environmental Design - the series of rating systems aimed at increasing the environmental and health performance of buildings, sites and structures and of neighborhoods. Leadership in Energy and Environmental Design covers the design, construction, and operation of all types of buildings.	Commercial: all Industrial: all Mixed use: all Residential: all	New construction Existing buildings Additions	Sustainable sites Energy efficiency Water efficiency Materials and resource use Indoor environmental quality Emissions Operations and maintenance

<p>The International Living Future Institute's <i>Living Building Challenge</i> - the certification system that advocates for transformation in the design, construction, and operation of buildings. In addition to encouraging improved environmental and health performance, it supports building structures that are restorative, regenerative, and an integral component of the local ecology and culture.</p>	<p>Commercial: all Industrial: all Mixed use: all Residential: all</p>	<p>All</p>	<p>Sustainable sites Energy efficiency Water efficiency Materials and resource use Indoor environmental quality Equity Aesthetics</p>
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Source: compiled by the authors on the basis of the sources¹²⁰

In modern society, exhausted by worldwide ecological problems, in our opinion, it is needed to talk about not just economic, but “green” economic growth.

If we discover the benefits of the categories “green economic growth”, “green economy” and “sustainable development”, we may analyse them from economic, social and ecological points of view¹²¹.

¹²⁰ International Code Council's 2012. International Green Construction Code. Available at: <https://www.epa.gov/smartgrowth/international-code-councils-2012-international-green-construction-code-igcc>; Standard for the Design of High-Performance Green Buildings Except Low-Rise Residential Buildings (ASHRAE 189.1). Available at: <https://www.epa.gov/smartgrowth/ansiashraeusgbcies-standard-1891-2014-standard-design-high-performance-green-buildings>; Green Globes. Available at: <https://www.epa.gov/smartgrowth/green-globestm>; US Green Building Council's Leadership in Energy and Environmental Design Available at: <https://www.epa.gov/smartgrowth/us-green-building-councils-leadership-energy-and-environmental-design-leedr>; The International Living Future Institute's Living Building Challenge. Available at: <https://www.epa.gov/smartgrowth/international-living-future-institutes-living-building-challenge-tm-version-30-2014>

¹²¹ Prushkivska E.V., Shevchenko Yu.O. (2013): The development of the "green economy": the national dimension. BUSINESSINFORM,3. Available at: http://business-inform.net/pdf/2013/3_0/186_191.pdf; Kibert C., Sendzimir J., Guy G. (Eds.). (2000). Defining an Ecology of Construction. Construction Ecology: Nature as the Basis for Green Buildings. New York: Spon Press, 7-28.

Starting from green economic growth, we may mention ensuring the constant economic progress considering the surrounding environment, more stable and flexible environment ensures the economic growth using green technologies, innovations. The social aspect of green economic growth is represented as providing the achievement of well-being, in particular social, providing access to the poorest level of the population to main goods, pleasure demand in food production, transport services, housing construction and providing energy.

Continuing with green economy, it is needed to mention such economic aspects: ensuring the economic growth, increasing the volume of income and employment, attraction of public and private investments, creation of flexible economy with new economic activities. The social aspects are: involving the achievement of human welfare, social fairness, better quality of life, social development, reduction of social unevenness, fair access to limited resources. The ecological benefits of green economy are that it focuses on reducing environmental risks, deficits citation, carbon emissions into the atmosphere and environment pollution; increasing efficiency usage of resources and energy, requires the responsibilities and load limitations on the ecological the system from all subjects of environmental management.

Ecological aspect is manifested in keeping and preserving natural their assets, the creation of low-coke production effective use fewer resources and energy, quantity reduction emissions and minimization of pollution and environmental impact environment; ensuring climate and environmental sustainability; establishing harmony between economic interests and the state of the environment and its protection.

Finishing with economic benefits of sustainable development we may emphasize the limitation of production growth and consumption in economically developed countries, support sustainable economy, development and introduction of new technologies, reduction investment in the industry that exploit nature. Social aspect: provides preservation of human capital and reduction of quantity destructive conflicts, fair distribution of resources among all members of society, achievement of a decent life and

welfare. In addition, the ecological aspect is represented by providing stability of biological and physical systems by supporting the usage of secondary raw materials, minimizing quantity of waste, distribution of the reproductive energy sources, construction of treatment plants and factories for household recycling and industrial waste reduction of area under garbage cans¹²².

Based on the research of V. Potapenko, we may analyze the place of Ukraine according to indicators of sustainable development. Such economically developed countries as Switzerland, Sweden, Japan, Germany and the USA have significantly advanced towards sustainable development. Other countries are far from this, unfortunately, Ukraine is among them.

Therefore, today it makes sense to analyze the experience of the way of the transition of developed countries to the green economy (Table 3).

Table .3. The comparative characteristic of the countries sustainable development indicators

Index	Country						
	Switzerland	Sweden	Norway	Japan	Germany	The USA	Ukraine
Environmental performance index	8,91	8,6	8,11	7,25	7,32	6,35	5,82
Global Competitiveness Index	5,63	5,56	5,14	5,32	5,39	5,43	3,9
Economic freedom	3,05	3,1	2,7	2,5	2,9	3,2	1,35
Human Development Index	0,947	0,949	0,963	0,943	0,93	0,944	0,776

¹²² Nwafor, J.C. (2006). Environmental Impact Assessment for Sustainable Development. Enugu: Eldermark Publishers; Woolley, T.(Ed). (2000). Green Building: Establishing Principles. Ethics and the Built Environment. Warwick Fox. Rutledge, London: 44-56.

Growth of GDP, %	2	2,7	1,5	3	3,6	2,7	4,3
GDP per capita, thousands of dollars	4,29	3,9	5,91	3,42	3,59	4,74	0,67
GDP, billions of dollars	0,326	0,354	0,276	4,338	2,96	14,72	0,306
Population growth	0,21	0,16	0,33	-0,28	-0,21	0,96	-0,62

Source: "State policy of sustainable development on the principles of "green "economy" data¹²³

Companies with green solutions have also improved financial efficiency, as when compared to conventional businesses that do not implement green applications. Business' survival in the current harsh economic times calls for efficiency and innovations. As a result, green remodeling and building are quickly becoming hallmarks of contemporary business efficiency. Main benefits of the green construction implementation are the availability of demand, the reduction of operational costs, competitive advantages, and international recognition. A construction company that has sufficient sustainable solutions has reduced energy and operation costs. For instance, resorting to solar power instead of electricity can help cut down utility bills by almost 30%. Moreover, in the developed countries, construction that leverage green technology are eligible to receive tax incentives from the government. The extra cash can then be invested in the operations of the business, thus increasing overall service provisions. While the installation costs of green buildings might be slightly more expensive initially, the long-term benefits are more reasonable. The green technologies are designed to use resources more efficiently, which in turn, leads to reduced costs for owners. Many companies are realizing the need for green technologies and are slowly adopting such methods in their businesses. For instance, buildings that incorporate

¹²³ V. Potapenko "State policy of sustainable development on the principles of "green "economy". Analytical note. Available at: <http://www.niss.gov.ua/articles/1237>

solarenergy systems use up to 70% less electricity than conventional systems, according to the U.S Department of Energy¹²⁴.

The economic benefits of green buildings in 20 years perspective are represented in the Table 4.

Table 4. The profit from a green building

Category	Net Presented cost for 20 years, Dollars USA per 1 sq.m.
Energy saving	60,7
Reduction of emissions	12,9
Water saving	5,4
Savings on exploitation and Service	91,5
Increased productivity, improved hygiene of labour and housing	397,0 – 595,0
Average rise in the construction cost	-32,3 – 53,8
Total:	535,2 – 711,7

Source: compiled by the authors on the basis of the source¹²⁵

Talking about the green construction state promotion measures, we want to emphasise the experience of the USA, the UK and Germany (Table 5). Today, among all countries, due to the indexes of growth and volumes of the market of green construction, the US is leading, where, the green building is stimulated mainly by the state financial and tax support. In Germany, the general level of energy efficiency of construction is very high, which is ensured by high requirements in the standards. The advantage of Great Britain and Germany is the fact that the state encourages additional initiatives on the use of renewable sources of energy in construction through the establishment of additional requirements for the respective budgets.

¹²⁴ U.S Department of Energy. Available at: <https://www.energy.gov/science-innovation/energy-efficiency>

¹²⁵ CEN/TC 350 – Standards under development. Available at: <http://www.cen.eu/CEN/Sectors/TechnicalCommitteesWorkshops/CENTechnicalCommittees/Pages/WP.aspx?param=481830&title=CEN%20FTC+350>.

Table 5. Comparison of green construction promotion measures in different countries

Promotion measure	The USA	The United Kingdom	Germany
CO2 emissions reducing policy	15% lower by 2020, compared with 2009	34% lower by 2020, compared with 1990	40% lower by 2012, compared with 1990
Normative-legal base of construction	It is determined by the states	A unique method for calculating energy efficiency was developed and approved	Energy efficiency standards were developed in 1977 and constantly became stronger
Energy Efficiency Certification	Energy Star, obligatory for new construction	Energy Performance Certificate, is obligatory for a new construction and Display Energy Certificate	Energy Performance Certificate, is obligatory for a new construction
National environmental standard	LEED	BREEAM	DGNB
Financial Initiatives	A lot of taxes benefits, compensation for the cost of certification	The budget for renewable energy sources is relied on market mechanisms	The promotion of renewable energy sources
The National Council for Green construction	USGBC, 13213 members, (2008)	UKGBC, 200 members, (2008)	DGNB, 300 members, (2010)
Social Responsibility of business	Strongly developed	Strongly developed	Strongly developed

Source: compiled by the authors on the basis of the source¹²⁶

For a truly effective transition to a green economy model, it is necessary to find opportunities and means to solve problems in all spheres in a complex

¹²⁶ International practice of green building. United Nations Development Program. (2011): Global Environment Facility. Available at: www.undp.org

way. In order to develop a phased transition of Ukrainian construction industry to green one, we will return to the sectors of the economy. Construction, like every industry, refers to the secondary sector of the economy, and therefore most needs the rational use of energy. Increasing energy efficiency in construction is one of the promising directions that will promote energy saving, reduce emissions and create new jobs. Right together with the direct effect, the "greening" of the construction industry causes a number of related effects: improving the comfort of dwellings, extending the life of the buildings, increasing employment in related industries, reducing the consumption of imported resources, etc. However, the qualitative development of green building is not possible without the tertiary sector - the sphere of services. The tertiary sector is the connecting link within the secondary sector, which ensures the implementation of the concept of a "green economy".

This sector is like a system of industries and activities related to the provision of services to both the population and business. Right this sector covers comprehensive research and development, creation of business plans and programs, development of energy-efficient technologies that can provide qualitative changes in the direction of greening the secondary sector, in particular construction. Creating eco-innovations will improve production processes, effectively organize the business at the expense of resource savings, as well as improve the commercialization and implementation of clean technologies.

Scientists mention a lot of market mechanisms and economic instruments for the transition to the principles of the "green economy":

- 1) public and private investments in green building;
- 2) exchange of environmental technologies between countries;
- 3) public procurement policy, which stimulates the production of environmental friendly products;
- 4) targeted state support for research and development related to the creation of environmentally friendly technologies;

- 5) tax-budget reforms - development and introduction of appropriate environmental taxes on the basis of the polluter pays principle;
- 6) the introduction of a subsidy for environmental production and the corresponding abolition of resource-intensive production.

However, today the analysis of the existing state of the economy gives an opportunity to talk about the delay of the full implementation of the approaches presented for the transition to a green economy. Therefore, we consider it makes sense to turn to the experience of methodological support for the transition to a green economy.

We would like to offer for transition to the green economy referring to the principles of Threshold-21 model, a model that was developed in 1980 by the Millennium Institute in the USA for a complex long-term planning of sustainable national development and successfully implemented in a lot of countries¹²⁷. There are a lot of opposite opinions between the scientists according to this model. But we agree with understanding of this model as the one that integrates the economic, social, natural, resource blocks into a single simulation model for achieving a stable state in a single state (more than 800 parameters and even greater number of equations connecting them), in a group of states and for the world as a whole. This allows us to build dynamic models for integrated long-term planning of national development. The peculiarity of the model is its "clearness" - the structure of the model is interpreted in a meaningful way, not only for developers with high mathematical qualifications, but also for customers (politicians, economists, managers, environmentalists, doctors, etc.). Therefore, if the simulation results of a scenario do not satisfy the researcher, he can look at the modeling process and determine which variables affected the unexpected result. The variables can later be corrected in a new scenario, and the simulation is repeated until the desired result is achieved.

The model has the following key characteristics: integrates economic, environmental and social elements using a system dynamics approach, helps

¹²⁷ Threshold-21 <http://ledsgp.org/wp-content/uploads/2015/10/T21-Overview1.pdf>

create sustainable development strategies and policies by simulating possible impacts of alternative policy choices and strategic options; facilitates transparency, participation, and consensus building by encouraging open consultations with diverse stakeholders and external development partners within a common framework and an easy-to-understand interface; flexible and can be customized to address the unique needs of individual countries through the use of a modular design where existing sectors can be modified and new sectors can be added; produces output for policy documents including a national budget, national development plans, the Country Assistance Strategy, the Poverty Reduction Strategies or UN Development Assistance Framework. The model differs from almost all other global macroeconomic models; it understands the natural resources as a factor of production.

The Environment sphere tracks pollution created in the production processes and its impacts on health, and eventually on production. It also estimates the consumption of natural resources, both renewable and non-renewable, and can estimate the impact of the depletion of these resources on production and other factors. It also examines the effect of soil erosion and other forms of environmental degradation and their impact on other sectors, such as agricultural productivity and nutrition. Additional issues addressed are fossil fuel use, forest depletion, land and water degradation, air and water pollution, and greenhouse gas emissions. That is why, on our opinion, this model may be used for the modelling of national transition to the green economy.

Conclusions. One of the components of the national economy of Ukraine, which creates the basis for its social and economic development, is the construction industry. It is one of the most important sectors of the national economy. The competitiveness of the Ukrainian economy as a whole depends on the level of development of the construction industry, its

competitiveness. That is why we believe that development of green technologies and transition to green construction widespread in Ukraine will become the driver for the transition to the green economy as a whole. The implementation of green construction standards will lead to environmental stability, which is of great importance not only inside the boundaries of our country but is needed all over the world.

Due to world trends in the investment and construction activities, there are transformational changes in the direction of reducing energy consumption in systems of life support of buildings, fundamental changes in the civil and industrial construction in general. "Green construction" is the result of these changes. That is why green construction here can be understood as a priority direction of the green economy formation. The environmental direction, together with the energy saving and non-emergency technologies introduced in the construction, will provide a stable and long-lasting demand for green buildings among the people. This trend is easily formed by a public opinion, law projects of the state, aimed to implement the green technologies into states. Companies are always looking for alternative solutions to help cut down on costs. The construction industry for sure can benefit from green energy solutions in many ways. Researches have shown that there is a compelling need for the construction industry to adopt green technologies. The green buildings are not just about maintaining the environment, but sustainable solutions make genuine sense for a construction company. It is important to note that businesses adopting green solutions are more likely to attract clients than their counterparts. This benefit relates to corporate social responsibility of the given company whereby they are inclined to give back to the society in one way or another. For many people all over the world a company, which is concerned itself with preserving the environment, will look more attractive.

It is needed to emphasize one of the main conclusions: the transition of the Ukrainian economy to a green one nowadays stimulates economic growth, an income increase and an employment level. Although in the short term in the green scenario economic growth rates may be lower than in the usual scenario development, but in the long term the transition to a "green" economy will achieve higher performance for our country.