MINISTRY OF ECONOMIC DEVELOPMENT AND TRADE OF UKRAINE

EaPGREEN Partnership for Environment and Growth

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Report on Green Transformation in Ukraine

Based on OECD Green Growth Indicators

OCTOBER 2016

Report on Green Transformation in Ukraine

BASED ON OECD GREEN GROWTH INDICATORS

Authors and sources of the report

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Abbreviations

CIS	Commonwealth of independent states
EaP	Eastern Partnership
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
GDP	gross domestic product
GGI	green growth indicator(s)
GNI	gross national income
GVA	gross value added
HSW	household and similar waste
IEA	International Energy Agency
ILO	International Labour Organization
ISIC	UN International Standard Industrial Classification of All Economic Activities
kgoe	kilogram(s) of oil equivalent
Mln	million
OECD	Organisation for Economic Co-operation and Development
pp	percentage point(s)
PPP	purchasing power parity
R&D	research and development
toe	ton(s) of oil equivalent
UAH	Ukrainian Hryvnia
UN	United Nations
UNECE	United Nations Economic Commission for Europe
UNEP	United Nations Environment Programme
UNIDO	United Nations Industrial Development Organization
WHO	World Health Organization

Ukrainian economy in figures

Indicator	2015
Area (km^2):	603.6
Population (as of 01.01.2016)*:	42.8* million
Gross national income per capita (PPP, the World Bank)	USD 7,810
GDP, real growth, %	– 9.9%
Number of employed persons*:	16.4 million
Labour force participation rate, 15-70 age group*	62.4%
Employment rate, 15-70 age group*	56.7%
Share in gross value added (GVA):	
• industry	23.5%
• agriculture, forestry and fishery	11.7%
• services	62.2%

* Exclusive of the temporarily occupied territory of the Autonomous Republic of Crimea the city of Sevastopol and the area of ongoing antiterrorist operation. *Source:* Ukraine in figures 2015 –www.ukrstat.gov.ua.

Environmental performance

Indicator	Value
Ecological footprint (2012), 2016 Global Footprint Network	2.8 global ha per capita
Environmental Performance Index (ranking), Yale University	44th out of 180 countries in 2016 95th out of 180 countries in 2014
Energy intensity of GDP (at PPP), IEA, 2013	0.34 toe/1000 2005 USD
Carbon intensity of GDP (at PPP), IEA, 2013	0.77 kg CO_2/2005 USD

1. UKRAINE ON THE WAY TOWARDS GREEN GROWTH: NEW CHALLENGES AND OPPORTUNITIES

1.1. The concept of green growth as a practical tool for achieving sustainable development goals

All countries, regardless of their natural resource base or geopolitical position, to a greater or lesser degree face the challenges of depletion of limited natural resources and climate change. Response to these challenges requires the models of economic growth reflecting a closer interaction between economy, environment and quality of life. The use of such models may facilitate more informed policy decision making for sustainable development of national economies.

At the global level, the framework for addressing these issues was established by *Agenda 21* adopted by the UN Conference on Environment and Development (1992, Rio de Janeiro, Brazil), the recommendations of the World Summit on Sustainable Development Rio+10 (2002, Johannesburg, South Africa) and the decisions of the UN Conference on Sustainable Development Rio+20 (25 June 2012, Rio de Janeiro, Brazil), at the regional level commitments were identified by the Eighth Conference Environment for Europe (Batumi, Georgia, 2016).

Acknowledging that progress towards green growth had been insufficient, the outcome document of the Rio+20 Conference *The Future We Want* expressed support to various initiatives in the field of "green economy", "green growth" and "inclusive green growth" put forward by international organisations with a view to further advancing the concept of sustainable development with due regard to current realities and applying a more pragmatic approach to its implementation.

According to the new global *2030 Agenda for Sustainable Development* adopted on 26 September 2015 by 193 countries at the UN Sustainable Development Summit, inclusive transformational economy based on sustainable production and consumption patterns is an important factor in providing a new impetus to the development. At the same time, the 17 interconnected Sustainable Development Goals (SDG) adopted by the Summit require a systemic approach to the greening of national economies and need for monitoring.

In line with the recommendations set forth at a ministerial conference of its member-countries, the OECD has been developing the green growth concept since 2009. Green growth is about fostering economic growth and development while ensuring conservation and rational use of natural assets so that they continue to provide raw materials, energy, water and multiple ecosystem services on which the well-being of countries relies (OECD, 2011).

It is worth noting that the green growth concept does not replace the concept of sustainable development, but is meant to be a practical tool for achieving sustainable development goals. Both concepts are based on the principles of interaction between society and nature and aim to address the needs of not only present, but also future generations.

Distinctive features of the OECD green growth concept and strategy include the following assumptions:

(1) natural capital is viewed as a factor of production, as productive capital whose recovery and growth require investments;

(2) environmental policy is seen as an investment strategy aimed at a more efficient use of natural resources through the development and employment of state-of-the-art resource- and energy-efficient low-carbon technologies;

(3) green activities and eco-innovations are meant to advance structural transformation, to improve labour, capital and resource productivity, and to support the implementation of "new wave" technologies and infrastructure upgrades;

(4) close correlation between economic and environmental policies is ensured by means of such instruments as fair pricing and taxation promoting resource-saving behaviour, introduction of stricter, but more motivational environmental standards and technical regulations, reform of the existing system of energy subsidies, and implementation of an expanded system of indicators for assessing performance and facilitating political decision-making in these areas.

Progress towards green growth is dependent on several preconditions: inclusion of green transformation goals in the country's key development priorities; full support of green growth principles by relevant agencies; and a consensus based on dialogue between the authorities, the business community and the public. Political decisions should be based on multiple trade-offs required to balance such competing goals as ensuring economic growth and maintaining profitability, addressing social issues and conserving the environment.

As in other EaP countries, the greening of the economy in Ukraine is taking place in the context of continuing transition to a market-oriented business environment and related institutional changes. This is a lengthy and complicated process of transition from a society based on centralised decision-making, administrative pricing, low social standards and egalitarianism (none of which encourage rational use of cheap energy and primary resources) to a society where market competition induces all enterprises to increase added value at a lesser cost in the context of higher labour and resource prices while motivating the population towards rational consumption and a more responsible behaviour. This complex transformation often means that such issues as clean environment and resource-saving are put on the back burner. For this reason, positive results in these areas may serve as an important indicator of progress in economic reforms, and the OECD GGI set is an adequate instrument for such an assessment.

Green transition which requires well-grounded systemic decisions, proper consideration of the national context and openness should be promoted through appropriate instruments of public policy.

The *Greening Economies in the Eastern Neighbourhood Countries* programme (EaP GREEN) supported by the European Commission and other donors and implemented by four partner organisations – OECD, UNECE, UNEP and UNIDO – aims to contribute to green transition in three major areas: (a) shaping of a strategic policy framework and implementation of reforms necessary for the greening of the economy; (b) integration of strategic environmental assessments into the preparation of development plans and programs at national, local and sectoral levels; and (c) implementation of demonstration projects related to resource-efficient cleaner production and organic farming.

1.2. Green transformation in Ukraine: new challenges and opportunities

Ukraine belongs to resource-rich countries of the Eurasian region, enjoys a favourable geographical and geopolitical position, has a highly educated population and potentially can serve as a transit corridor for energy and trade flows between the East and the West. Ukraine is among the leading countries of the world in terms of proven reserves of iron, manganese and titanium- zirconium ores, coal, graphite, china clay and sulphur.

Yet, according to the World Bank, the Ukrainian economy which is to a significant extent based on low value-added exports is largely inefficient and therefore, in terms of per capita GNI, the country belongs to the lower-middle-income group (USD 7,810 at PPP in 2015). A high degree of fixed assets depreciation (83.5% in 2014) and outdated technologies, especially in the mining and metallurgical sector, result in excess consumption of primary resources, materials and energy. As a result the energy intensity of Ukrainian economy (0.34 toe/1000 USD in 2013, according to IEA estimates) is 1.5 times higher than the EU average.

Today Ukraine is facing a number of serious problems caused by the escalating conflict in the eastern part of the country, the occupation of the Crimea and an ongoing economic crisis. Coupled with accumulated structural problems, in 2015 this lead to a 9.9% slump in the GDP and a 13.4% decline in industrial production. At the backdrop of severe resource limitations and imminent external threat, the conversion of Ukraine's economic development model and structural transformation are becoming a matter of survival.

The signing in 2014 of the Ukraine-EU Association Agreement and the adoption of the 2014-2017 action plan for its implementation (in particular, the *Economic and Sectoral Cooperation* section), as well as the approval of plans for implementing EU directives and regulations related to energy, environment and technical guidelines are all geared towards Ukraine's transition to the European green development model.

The *Ukraine-2020* Sustainable Development Strategy adopted in January 2015 sets forward ambitious goals in respect of economic reforms designed, among other things, to ensure sustainable economic development without depleting the environment, while the Action Plan for the implementation of the Ukraine-2020 Strategy proposes integrated solutions for reforming environmental management and monitoring systems. They include:

- gradual harmonisation of Ukrainian legislation with EU directives as required by the Association Agreement (Chapter 6 on *Environment*);
- introduction of environmental impact assessment procedures with regard to plans and programmes as required by Directives 2011/92/EC and 2001/42/EC;
- introduction of the five-stage waste management hierarchy as required by Directive 2008/98/EC on waste and preparation of action plans in the area of waste management;
- increase in the share of utilisation of municipal solid waste and maximising reuse and recycling of such waste;
- introduction of the "polluter pays" principle and extended producer responsibility, in particular for packaging;
- reform of the system of pricing and tariff setting for energy and fuels, revision of mechanisms ensuring the balance of energy, phasing out of cross-subsidies;
- creation of a government support mechanism to promote energy efficiency measures in residential buildings and state-financed organisations.

In addition, the action plan of the Cabinet of Ministers for 2016 aimed at supporting the implementation of the *Ukraine-2020* Sustainable Development Strategy and the Implementation Plan of the EU Association Agreement contains a comprehensive package of tasks geared towards the green transformation of Ukraine's economy.

These include energy performance improvements, energy market reforms, revision of subsidies for the population, improvement of housing and utility services, development of the renewable energy sector, carrying out of the thermo-modernisation programme for the population, creation of favourable conditions for small and medium-sized businesses, modernisation of the industrial complex and the system of support for agricultural producers. Reforms of environmental and taxation policies and the government procurement system should be aligned accordingly.

It is expected that the greening of the economy will promote:

- creation of less resource-intensive sectors of the economy, new markets and new jobs;
- introduction of new energy efficient technologies and revitalisation of innovation activities;
- higher labour productivity and business competitiveness through the efficient use of energy and resources and waste minimisation.

Ukraine does have a potential for advancing green economic activities, primarily in the fields of renewable energy, energy performance and organic farming. For instance, in 2010-2014, the average annual growth in the bioenergy sector amounted to 42% while, according to the national renewable energy action plan up to 2020, the share of renewable energy in the gross final energy consumption is expected to reach 11% (8,590 toe).

In line with the national energy efficiency action plan for the period up to 2020, in 2020 final energy consumption should be 9% lower than the 2005-2009 annual average. The greatest savings in energy consumption are expected in the housing (50% of the total volume) and industrial (25%) sectors. To that end, a massive thermo-modernisation programme for residential buildings is currently underway and industrial enterprises are now more actively engaging in resource efficiency and cleaner production projects and introducing energy management systems (ISO 50001).

On top of that, Ukraine has a great potential for organic farming. In 2014, the area used for growing organic crops reached 400.8 ha, the number of certified organic producers grew to 182 and the sales of organic produce were estimated at EUR 14.5 mln.

Implementation of two strategic documents related to development and adopted in 2015, namely *Agenda 2030* (UN Sustainable Development Summit, 26 September 2015, New York) and the new climate deal contained in the Paris Agreement (12 December 2015), requires that signatory countries reconsider their commitments in these areas.

In this context, Ukrainian experts are now defining scenarios and targets for a number of national-level policy documents: the Energy Strategy of Ukraine 2035, the SME Development Strategy 2020 and the State Programme for Agricultural Development 2020. In addition, the Environmental Strategy 2020 is undergoing revision and work has started on the Low-Carbon Development Strategy 2050 and the Industrial Development Strategy 2025. These documents are closely interrelated and aimed at helping Ukraine to abandon its flawed consumption model in favour of greener growth based on efficient use of inputs and energy-saving technologies.

1.3. The OECD set of green growth indicators

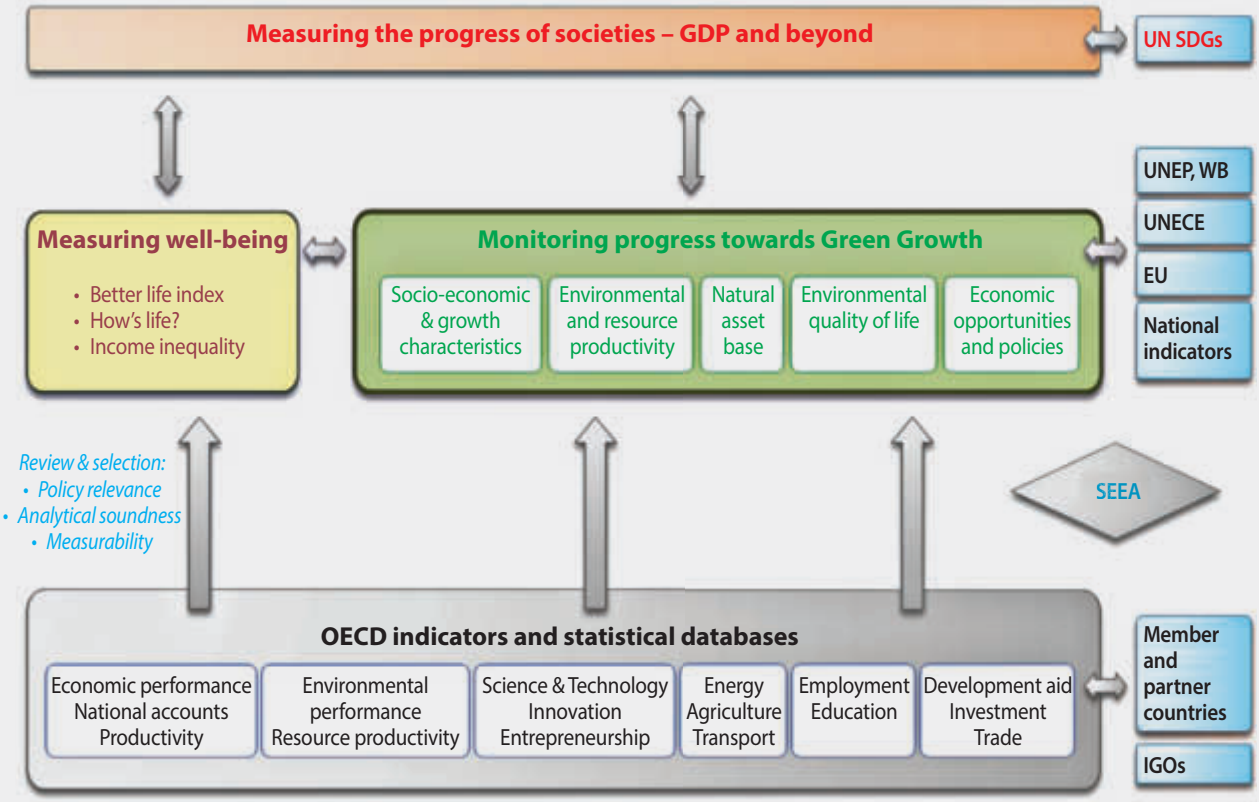
The OECD approach to monitoring progress towards green growth was presented in the 2011 report *Towards Green Growth: Monitoring Progress. OECD Indicators* published concurrently with the Green Growth Strategy; it was further elaborated in the 2014 edition of the report and then in *Measuring the green transformation of the economy. Guide for EU Eastern Partnership countries* (2016).

This approach is part of wider studies on measuring social progress which started in 2008 within the framework of the *Measuring society's progress* global project. This initiative seeks to establish a common system of key economic, social and environmental indicators that would facilitate the formation of an objective vision of possible ways to ensure the well-being of society in the future [1]. The scheme of interconnections between these indicators (Figure 1.1) is based on the information provided by UNEP, UNECE, EU, the World Bank and other international organisations. The adoption of 17 Sustainable developments goals by the UN Sustainable Development Summit on 26 September 2015 confirmed the relevance of such a broad approach.

The methodology and the system of indicators for measuring green growth are based on an analysis of various factors and outcomes caused by the interaction between the economic system and the environment, their effect on economic productivity and livelihoods of the population, as well as on an analysis of impacts brought about by public policy measures aimed at promoting growth (Figure 1.2).

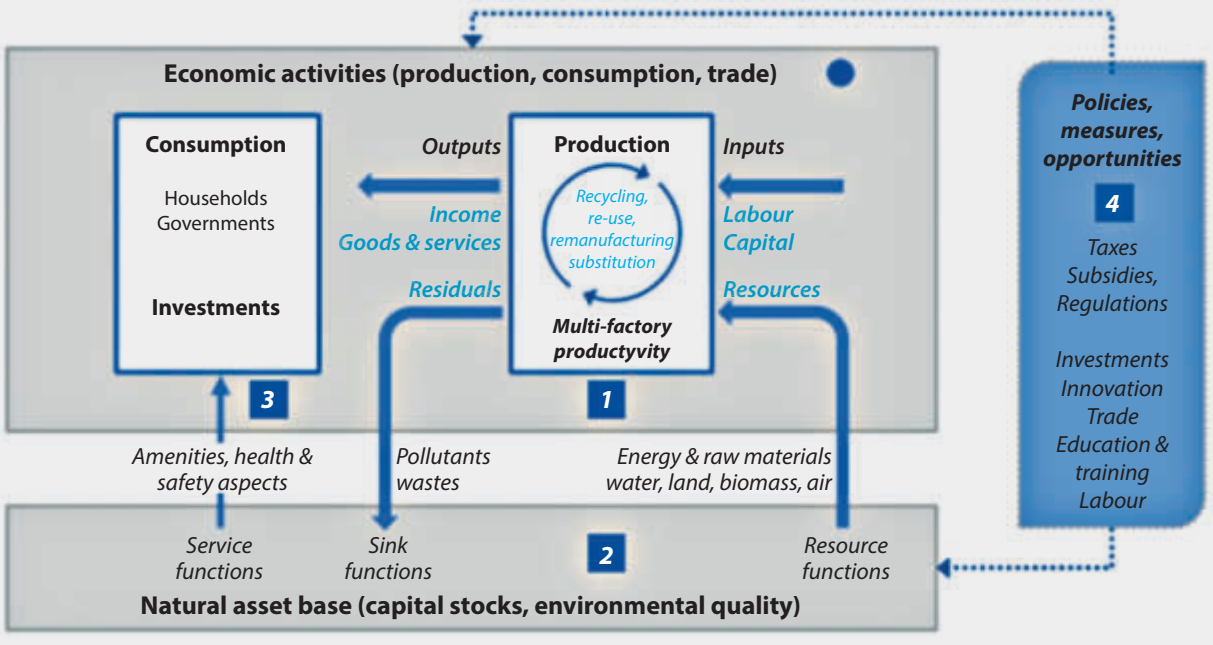
[1] Measuring society's progress, OECD project – http://www.measuringprogress.org.

Figure 1.1. Logic behind the indicators used for measuring social progress and well-being



Source: OECD, 2016. Measuring the Green Transformation of the Economy. Guide for EU Eastern Partnership Countries.

Figure 1.2. Cause-and-effect relationships between groups of economic, environmental and social indicators



Source: OECD (2011), Towards Green Growth. Monitoring Progress: OECD Indicators: – P. 17.

To monitor progress towards green growth, the OECD proposes to use five groups of green growth indicators (GGI), four of which reflect various dimensions of green economy, while the fifth group deals with macroeconomic indicators of a country's development (see Annex 1 for details). These groups are:

- environmental and resource productivity of the economy;
- natural asset base;
- environmental dimensions of the quality of life;
- economic opportunities and policy responses;
- socio-economic context and characteristics of economic growth.

Environmental and resource productivity indicators describe key aspects of transition to low-carbon and resource-efficient economy. In resource-rich countries of the Eastern Partnership, quantitative evaluation of these aspects rarely attracts proper attention. However, even in these countries the results of economic development and the quality of growth are increasingly dependent on natural environment, which is both the supplier of inputs (energy, water, materials) and the absorber of pollution and waste. Effective use of primary resources alongside waste minimisation, recycling and transformation into a useful resource increase business profitability (provided that prices for resources do not distort competition) and slow down the depletion of natural asset base.

In the interests of long-term stability of a country's development it is necessary to ensure that the **natural asset base** not only provides resources, but also performs absorption and service functions (biodiversity), and the pressure on the environment does not exceed its carrying capacity. To this end, indicators of reserves and flows of renewable (water, forests) and non-renewable resources (minerals) are monitored.

There is a direct link between the state of the environment and the quality of human life which should be captured with the help of the indicators of **environmental quality of life** reflecting health and safety risks, availability of amenities and eco-system services.

Indicators of **economic opportunities and policy responses** evaluate the effectiveness of government measures in support of green growth including investments in green activities and technology development, promotion of eco-innovations and green procurement, reforming environmentally harmful subsidies and pricing, etc.

The indicators related to the **socio-economic context and characteristics of economic growth** are used to reflect the results of green transformation at the macro level, such as mobilisation of additional sources of growth, changes in the structure of the economy, employment and labour market, rising incomes and competitiveness of businesses and the economy as a whole.

1.4. Adaptation of green growth indicators for Ukraine

The work on the adaptation of green growth indicators for Ukraine started in 2013. Approaches to this work and the first results were discussed at the international conference *Green and resource-efficient economy: new challenges and opportunities for economic growth in Ukraine* (21 November 2013, Kiev).

The outputs of the studies aimed at establishing of a system of key GGIs with due consideration of existing statistical and sectoral reporting procedures were discussed at two workshops in Kiev, in June 2014 and December 2015. Also of great assistance in this regard were the recommendations of the regional seminar for EECCA (Eastern Europe, Caucasus and Central Asia) countries on the integration of the Shared Environmental Information System in the pan-European region and OECD GGIs (Paris, March 2015).

The workshops in Kiev led to the establishment of an inter-agency working group made up of representatives from the Ukrainian Ministry of Economic Development and Trade, Ministry of Ecology and Natural Resources, State Statistics Service, as well as a number of research institutes and non-governmental organisations. In addition to that, the Ministry of Ecology and Natural Resources formed a working group tasked with the preparation of indicators to monitor the implementation of the goals set forth in the Strategy of State Environmental Policy of Ukraine up to 2020, with due regard to practices employed by UNECE, OECD and other international organisations.

Based on the results of the studies, two publications were prepared and presented:

Towards green growth: monitoring progress in Ukraine, a report by the Resource and Analysis Center "Society and Environment" (2014) assessing trends in indicator dynamics based on open sources and analysing availability of, and access to, relevant statistical data;

Measuring green growth in Ukraine: concepts, systems of indicators, experience and prospects for future application, a monograph by the Ukrainian Institute for Scientific and Technical Expertise and Information (2015) evaluating the alignment of Ukrainian statistics with the OECD GGI set and analysing the dynamics of data for 2000-2013 in comparison with OECD countries.

The present report proposes a set of GGIs adapted to the Ukrainian context and recommended for monitoring and measuring progress in Ukraine (Annex 1) and contains an analysis of trends in GGIs over the period of 2000-2014 comparing them with those in OECD countries.

Of more than 100 main and proxy indicators proposed by OECD in 2011 and 2014, eighty indicators were examined and 60 adapted for use in Ukraine, of which:

47 indicators fully conform to the OECD calculation methodology;
13 indicators conform partially, with slight changes in the methodology;
7 indicators cannot be monitored or calculated; these indicators from the OECD set were replaced with seven additional indicators.

It should be noted that while for most GGIs data are available since 2000, some of them can only be traced back to 2010 because of changes in the methods of their monitoring by the State Statistics Service.

Table 1.1 presents 60 GGIs that are in line with strategic development goals declared by Ukraine and can be used for assessing the effectiveness of green growth policies. It is particularly important to ensure an ongoing monitoring of indicators related to environmental and resource productivity; multifactor productivity; land use dynamics; life expectancy; funding of R&D aimed at reducing energy and resource consumption, waste and pollution; the structure of energy, materials and water consumption; and CO_2 emissions broken down by economic activities.

Table 1.1. A short list of green growth indicators for Ukraine

OECD GGIs by themes	Definitions of GGIs for Ukraine
Indicators of environmental and resource productivity of the economy	
Carbon productivity of GDP, USD/ton of CO_2: GDP per unit of CO_2 emissions of the energy sector (*GDP in constant 2010 prices at PPP, US Dollars)*	Carbon productivity of GDP, UAH/t CO_2: GDP per unit of CO_2 emissions from fuel combustion GDP in constant 2010 prices, UAH/t CO_2 and per PPP USD/t CO_2
	Index of changes in carbon productivity of GDP, % to 1990 and 2000
	Index of changes in volumes of CO_2 emitted, % to 1990 and 2000
	CO_2 emissions per capita, tons per person
Energy productivity of GDP: GDP per unit of energy used, USD/1000 toe (*GDP in constant 2010 prices at PPP, US Dollars)*	Energy productivity of GDP: GDP per unit of consumed energy, UAH/kgoe GDP in constant 2010 prices, at PPP, in UAH (base year 2010)
	Index of changes in energy productivity of GDP, % to 1990 and 2000
	Index of changes in energy consumption, % to 1990 and 2000
	Energy consumption per capita, toe per person
Material productivity of GDP (UAH/kg; USD/kg): GDP per unit of non-energy materials consumed, USD/kg (*GDP in constant 2010 prices at PPP, US Dollars)*	Material productivity of GDP (UAH/kg); (USD/kg)
	Index of changes in material productivity, % to 1990
	Index of changes in the volumes of non-energy materials consumed, % to 1990

OECD GGIs by themes	Definitions of GGIs for Ukraine
Waste management	Volumes of I-IV class waste generated, tons
	Volumes of household and similar waste generated, tons
	Volumes of household and similar waste generated per capita, kg
	Index of changes in the generation of I-IV class wastes, 2010=100
	Index of changes in GDP productivity relative to I-IV class waste, 2010=100.
	Index of changes in the volumes of household and similar waste, 2010=100
	Index of changes in GDP productivity relative to household and similar waste, 2010=100
Water productivity of GDP: GDP per unit of water consumed, USD/m^3 (*GDP in constant 2010 prices at PPP, US dollars)*	Water productivity of GDP, USD/m^3
	Index of water productivity of GDP, 1990=100
	Index of consumed water volumes, 1990=100
Balance of humus and nutrients	Balance of humus in Ukrainian soils, t/ha
	Balance of nutrients in Ukrainian soils, t/ha
	Application of nitrogen and phosphorus fertilisers, t/1000 ha
Indicators of availability and utilisation of natural resources	
Land resources	Distribution of land resources, % of the country's total territory
	Ploughland area, % of total territory
	Area of pastures and hayfields, % of total territory
Organic farming	Farmland under organic farming, ha
	Share of farmland under organic farming in the country's total area, %
Forest resources	Share of forests and forested areas in the country's total territory, %
Changes in land use compared to 1990 (by land use categories)	Changes in land use compared to 2001 (by land use categories), %
Water resources	Volumes of abstracted water per capita, m^3
Non-renewable resources	Extraction of basic mineral resources in Ukraine, mln tons, mln m^3
Indicators of environmental aspects of the quality of life	
Air pollution levels	Atmospheric emissions of the most harmful pollutants, thousand tons
	Emissions of nitrogen oxides per capita, kg/person
	Emissions of PM_{10} per capita, kg/person
Public health	Life expectancy at birth (years)
	Healthy life expectancy at birth (years)
	Growth in common disease incidence rates, %
Population with access to water supply and improved sanitation facilities	Share of households connected to centralised water supply, % of total households
Indicators of economic opportunities and policy responses	
Capital investments and current expenditure on environmental protection financed by the state budget	Capital investments and current environmental protection expenditure financed by the state budget, mln UAH
	Capital investments and current environmental protection expenditure financed by the state budget, % GDP
	Distribution of capital investments by types of environmental protection activities, % of total capital investments
	Distribution of current expenditure by types of environmental protection activities, % of total current expenditure

OECD GGIs by themes	Definitions of GGIs for Ukraine
Public funding of scientific research and innovations relevant to green growth	Budget expenditure on green research and innovations, mln UAH
	Share of budget expenditure on green research and innovations in the total public funding of scientific research and innovations, %
	Structure of public funding of scientific research by green areas, %
	Structure of public funding of innovations by green areas, %
Socio-economic context and characteristics of growth	
Economic growth and its structure	GDP growth rate, % to the previous year
	Structure of gross value added, %
Population	Number of inhabitants, mln
	Population forecast for the year 2050, mln inhabitants
Labour market	Labour force participation rate, age 15-70: % of economically active working-age population in the total number of people of corresponding age
	Employment rate in the 15-70 age group, % of employed persons aged 15-70 in the total number of people of corresponding age
	Unemployment rate, % of unemployed persons to economically active population (according to the ILO methodology)
Multifactor productivity in the economy as a whole	Multifactor productivity in the economy as a whole, calculated as the difference between the GDP growth rate and the growth rate of inputs (labour and capital for the whole of the economy)
Indicators of the effectiveness of policy decisions	Ease of Doing Business Index
	Global Competitiveness Index
	Environmental Performance Index
	Sustainable Society Index

1.5. Green growth indicator dynamics in Ukraine: a brief overview

Table 1.2. Dynamics of the main green growth indicators in Ukraine

Indicator definitions applied in Ukraine	10-year trend assessment
1. Environmental and resource productivity	
Industrial carbon productivity of GDP, UAH/kg CO_2	↗
Energy productivity of GDP: GDP per unit of energy consumed, UAH/kgoe	↗
Non-energy material productivity of GDP, UAH/kg	↘
Water productivity of GDP, UAH/m^3	↗
GDP productivity relative to I-IV class waste, UAH/kg	↗
GDP productivity relative to household and similar waste, UAH/kg	↘
Dynamics of soil fertility: balance of humus and nutrients per 1 ha of agricultural land, kg/ha	↘
2. Availability and utilisation of natural resources	
Changes in land use – share in the total land area	↘

Indicator definitions applied in Ukraine	10-year trend assessment
– ploughland, %	↗
– pastures, %	↘
– building land, %	↗
Land under organic farming, % of total agricultural lands	↗
Forests and forested areas	↗
Volumes of abstracted water per capita, m^3	↘
Volumes of non-renewable resources extraction	↘
3. Environmental aspects of the quality of life	
Dynamics of emissions of the most harmful pollutants:	
– nitrogen dioxide	↘
– PM_{10}	↘
– non-methane volatile organic compounds	↘
Share of households connected to centralised water supply	↘
Disease incidence growth rate among Ukrainian population:	
– circulatory diseases	↗
– respiratory diseases	↘
Life expectancy at birth, years	↗
4. Economic opportunities and policy responses	
Environmental protection expenditure, % GDP	↘
Share of state budget funds in environmental protection expenditure, of which :	
– current expenditure, %	↗
– capital expenditure, %	↘
Public funding of scientific research and innovations relevant to green growth	↘
5. Socio-economic context and characteristics of growth	
Share in Ukraine's gross value added (GVA), %:	
– industry	↘
– agriculture	↘
– services	↗
Total population	↘
Share of working-age population in Ukraine's total population, %	↘
Labour force participation rate, 15-70 age group, %	↘
Employment rate in the 15-70 age group, %	↗
Unemployment rate in the 15-70 age group	↗
Multifactor productivity growth rate	↗
Ranking according to the Ease of Doing Business Index	↗
Innovations and technological readiness (Global Competitiveness Index (GCI) of the World Economic Forum)	↗
Ranking according to the Environmental Performance Index	↗
Ranking according to the Sustainable Society Index	↗

2. GREEN GROWTH INDICATORS IN UKRAINE: ASSESSMENT OF TRENDS AND INTERNATIONAL COMPARISONS

2.1. Indicators of environmental productivity

2.1.1. Carbon productivity of GDP

Carbon productivity of GDP is the relation of the GDP in constant (2010) prices to the total volume of CO_2 emissions, while the index of changes in carbon productivity is the relation of the GDP growth index to the CO_2 emissions growth index.

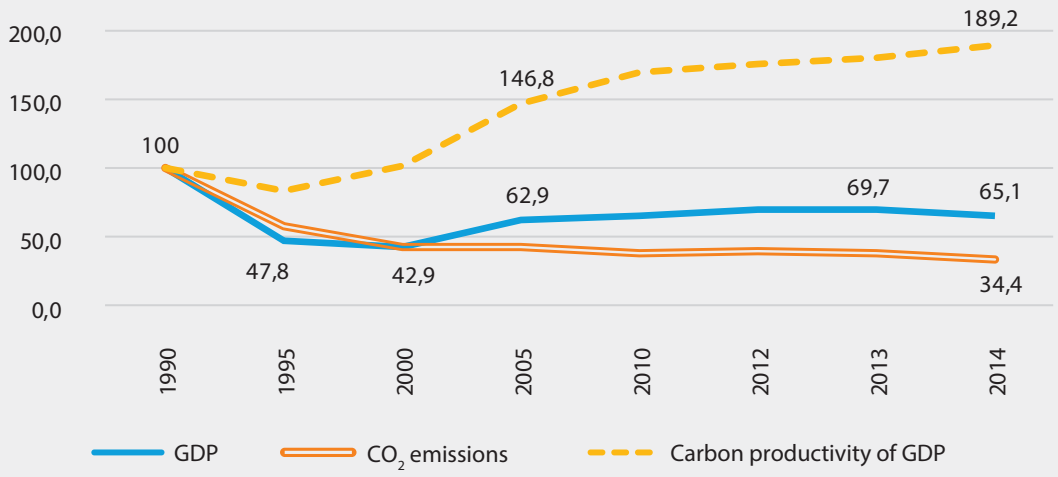
Compared to 1990, in 2014 the carbon productivity of Ukrainian GDP increased almost 2 times: from 2.4 UAH of GDP/kg CO_2 to 4.5 UAH of GDP/kg CO_2 (Figure 2.1).

Carbon productivity growth was influenced by the following factors:

In 1995-2000, reductions in CO_2 emissions were outpacing the GDP decline rates due to the downturn in industrial production and underemployment of production capacities;

In 2009-2011, there was a significant reduction in industrial output and the GDP brought about by the global financial crisis and accompanied by a smaller reduction in CO_2 emissions, which resulted in a decrease in carbon productivity;

Figure 2.1. Dynamics of GDP indices, CO2 emissions and carbon productivity of GDP, relative values, % (1990=100)



Note: GDP in constant 2010 prices
Sources: International Energy Agency, 2015. CO_2 emissions from fuel combustion (2015 edition); State Statistics Service of Ukraine, 2015. Statistical Yearbook of Ukraine 2014.

In 2014, a 10.1% reduction in industrial production resulting from the military aggression in the east of Ukraine and partial loss of markets in the CIS countries led to a decrease in CO_2 emissions and, consequently, a strong growth in the carbon productivity of GDP.

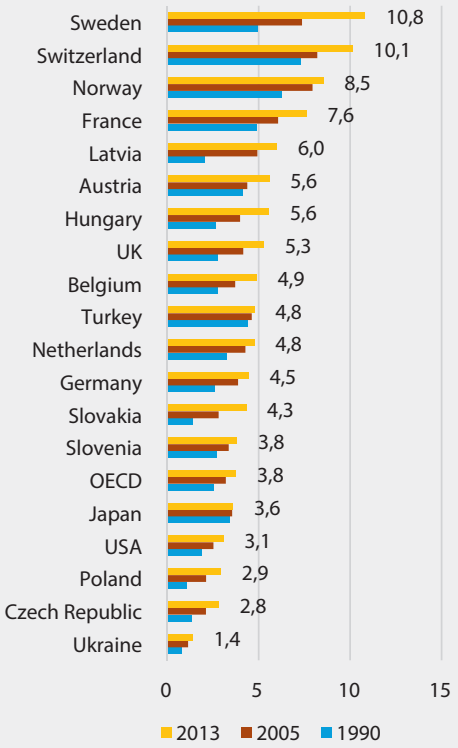
Decoupling of GDP and CO_2 indices was observed in 2003-2008 and in 2012-2014 due to the following structural changes in GDP: decreasing share of agriculture and industrial production and increasing share of services in the context of a significant rise in energy prices in 2012-2014[2] and energy savings enabling reductions in CO_2 emissions.

In Ukraine, the main polluters of CO_2 are the metallurgical industry (27.7% of the total CO_2 emissions from stationary pollution sources) and enterprises producing and distributing electricity, gas and water (54.7% of the total CO_2 emissions from stationary pollution sources).

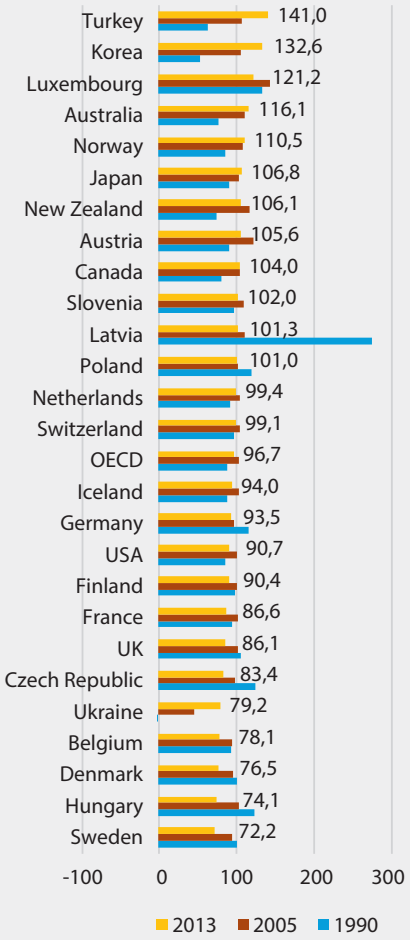
In 2013, carbon productivity of GDP in OECD countries on average exceeded Ukraine's performance by a factor of 2.7, while Sweden (the leader among OECD countries) performed 7.7 times better than Ukraine. Among other things, this is explained by Ukraine's lower GDP plus higher energy consumption, economic structure compared to other countries (Figure 2.2 a).

Yet in terms of carbon productivity growth rate and CO_2 emis-

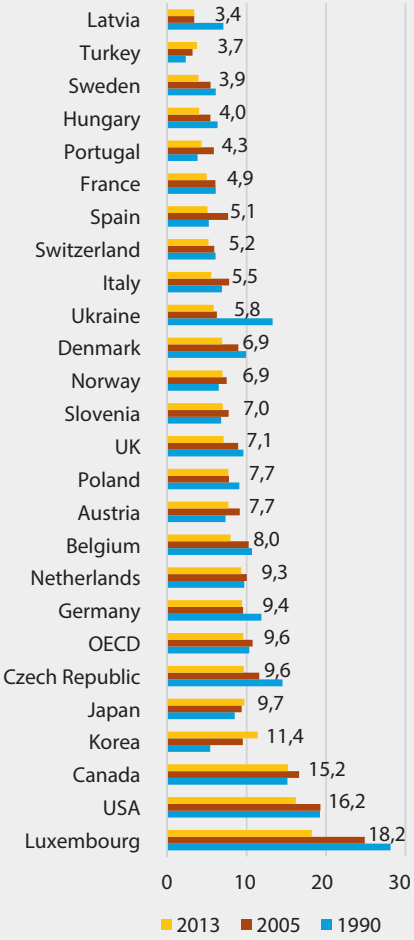
Figure 2.2. Carbon productivity of economy: in selected OECD countries and Ukraine (numerical values in the graphs refer to 2013)



(a) CO_2 productivity, GDP per unit of energy-related CO_2 emissions (US dollars per kilogram, 2010)



(b) CO_2 emissions, index 2000=100



(c) CO_2 intensity, energy-related CO_2 per capita (tonnes)

Source: Green Growth Indicators, http://stats.oecd.org

[2] In 2014, natural gas prices went up by almost 42% compared to 2013 prices.

sions per capita, Ukraine is closer to global leaders, ranking 19th and 10th, respectively, and outpacing the UK, Denmark and other countries (Figure 2.2 b, c).

Ukraine has ratified in September 2016 the Paris agreement and committed to reduce its greenhouse gas emissions by 2030 to 60% under the "active investment scenario" and 45% under the "pessimistic scenario" compared to 1990.

2.1.2. Energy productivity of GDP

Energy productivity of GDP is the relation of GDP in constant 2010 prices to the total volume of consumed energy, while the GDP energy productivity index of is the relation of the GDP index to the corresponding index of consumed energy.

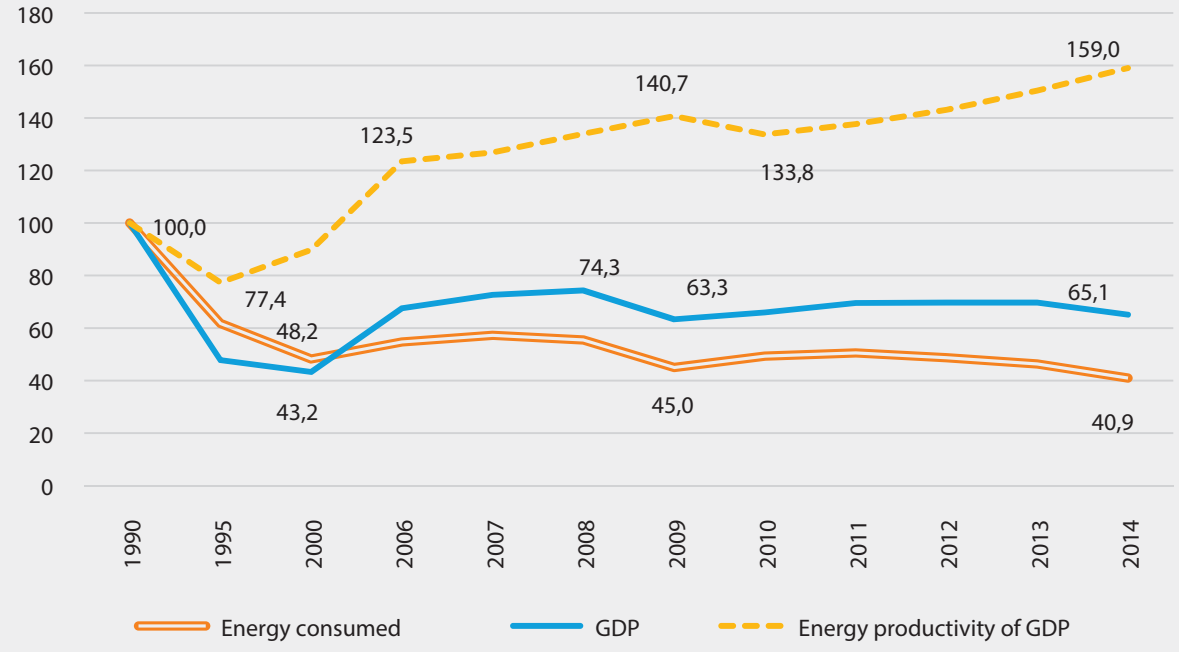
The energy supply structure, energy consumption intensity and their dynamics are key indicators of sustainability of a country's economic development.

In Ukraine, the energy productivity of GDP per total final energy consumed (in 2010 prices) in 2014 was 59% higher than in 1990, having grown from 10.9 to 17.3 UAH/kgoe (Figure 2.3).

The years 1990-1995 witnessed a disastrous decline in the GDP and energy consumption, but as the GDP shrank faster, the energy productivity took a deep plunge. After 2000, a period of economic recovery began, accompanied by GDP and energy consumption growth and corresponding increase in energy productivity. The gap between the GDP and energy consumption growth rates continued through 2008 due to the structural transformation of GDP (increasing share of the services sector and declining share of industry and agriculture), which contributed to a continued rise in energy productivity by almost 40% in relation to 1990.

In the crisis years of 2008-2009, energy productivity declined, beginning to grow again in 2010. The factors of this growth were high prices for imported energy resources (natural gas, oil, nuclear fuel) and moderni-

Figure 2.3. Dynamics of GDP indices, consumed energy volumes and energy productivity of Ukraine's GDP per energy consumed, relative values, % (1990 =100)



Sources: International Energy Agency. Ukraine: Balances: https://www.iea.org/statistics/statisticssearch/report/?country=Ukraine&product=balances&year=2013
State Statistics Service of Ukraine. Energy Balance of Ukraine, http://www.ukrstat.gov.ua/
State Statistics Service of Ukraine, 2015. Statistical Yearbook of Ukraine 2014.

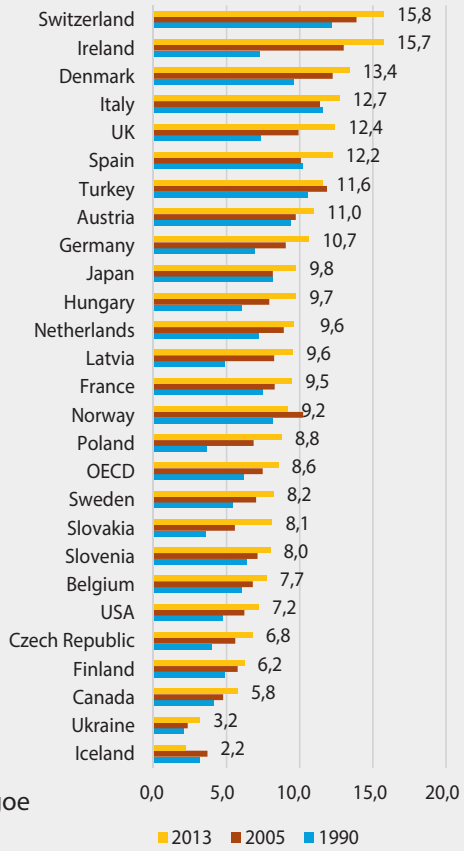
sation of power generation capacities. In 2014, the annexation of the Crimea and military aggression in Eastern Ukraine resulted in a decline in industrial production (by 10.1 percentage points) and a decrease in energy consumption outstripping the GDP decline rate? which led to a corresponding increase in energy productivity.

The largest energy consumers in Ukraine are the transport sector, households and the iron and steel industry. The greatest contribution to the growth in energy productivity of Ukraine's GDP was made by households and transport due to rising energy tariffs for the population and growing fuel prices for transport. The industrial sector increased its energy productivity by only 5.3%.

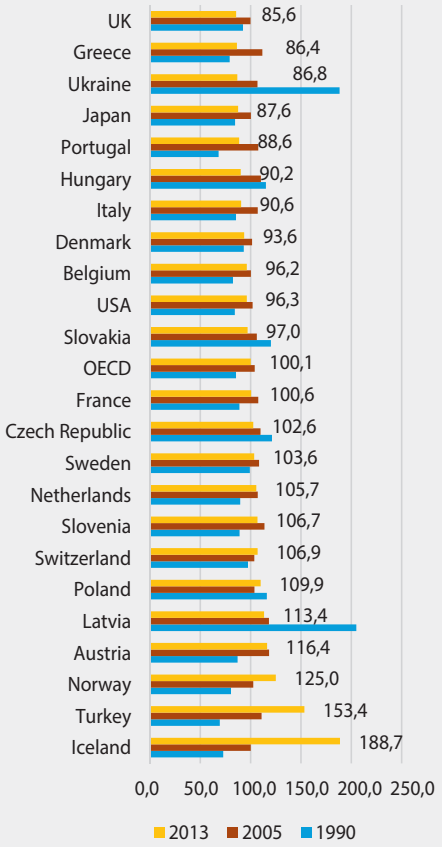
Despite the high rate of decline in energy consumption (by 16.4% in 2014 compared to 2011), in terms of energy productivity level Ukraine is second to last among OECD countries – Figure 2.4 (a) . On the other hand, in terms of the pace of reduction in primary energy consumption, Ukraine is among the leaders, on par with the UK and Greece, Figure 2.4 (b).

This situation is explained by a lower GDP growth rate (Figure 2.3) and a significant technological gap with developed countries in most economic sectors, particularly in energy-intensive industries.

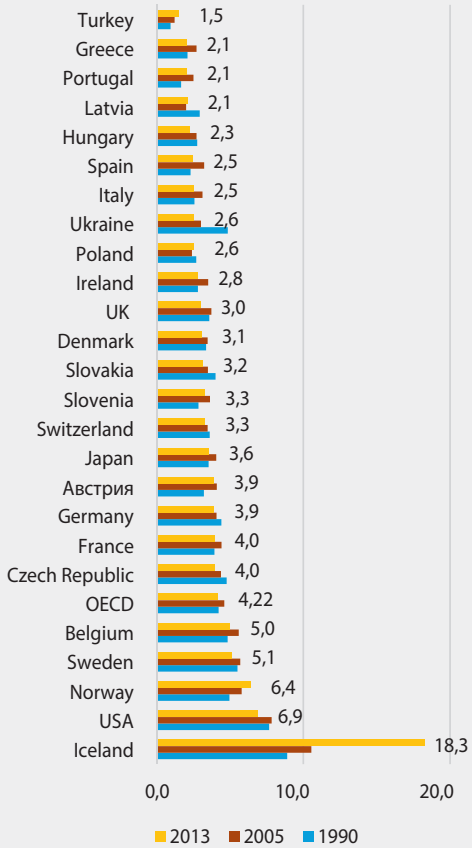
Figure 2.4.
Energy indicators in selected OECD countries and Ukraine (numerical values in the graphs refer to 2013)



(a) Energy productivity, USD/kgoe (GDP in 2010 prices, at PPP)



(b) Rate of changes in primary energy consumption (2000=100), %



(c) Primary energy consumption per capita (toe per capita)

Source: Green Growth Indicators, http://stats.oecd.org

According to the National energy efficiency action plan 2020, the reduction in energy consumption by end-users will amount to 9% of the 2005-2009 annual average figure by 2020, and to 5% by 2017.

2.2. Indicators of resource productivity

2.2.1. Non-energy material productivity of GDP

Material productivity of GDP is the relation of GDP in constant prices to the total volume of materials consumed countrywide, including imported and excluding exported materials, while the GDP material productivity index is the relation of the GDP index to the index of materials consumed.

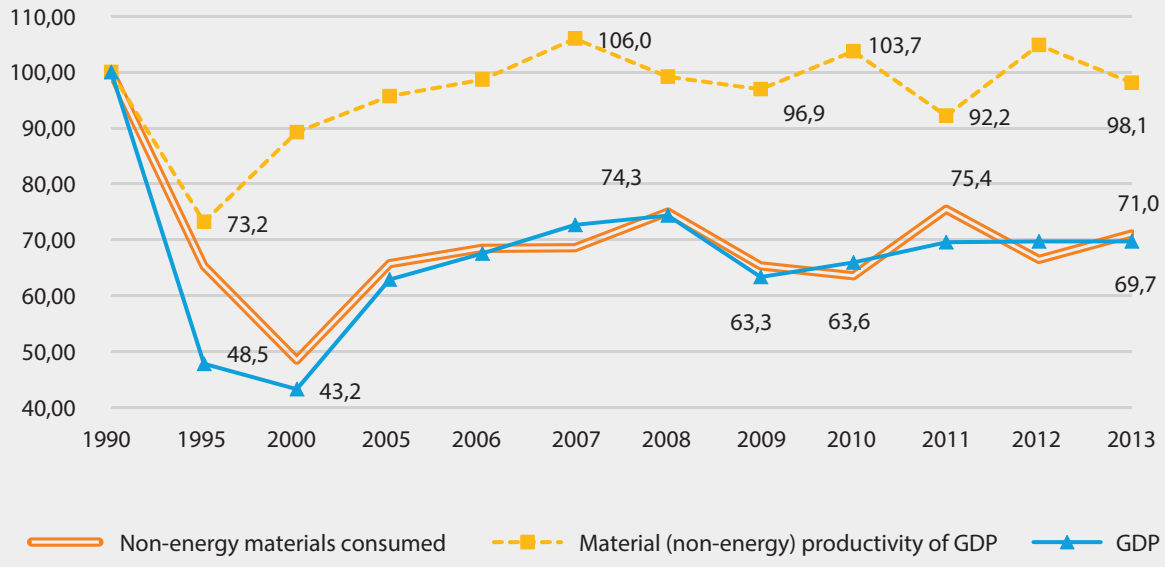
Domestic consumption of materials is calculated as the sum of the physical volume of extracted materials (energy resources, ores and non-metallic minerals) and produced biomass (agriculture, fishery and forestry products, and harvested timber).

Material productivity improvement policies encompass two areas: more efficient utilisation of material resources including extracted primary resources, and reduction, reuse and recycling of waste.

In 2013, the material productivity of Ukraine's GDP was 3.1 UAH/kg against 3.17 UAH/kg in 1990 (GDP in 2010 prices), having increased in 13 years by 2% only. The uneven dynamics of this indicator (Figure 2.5) points to the absence of a well-directed policy to stimulate the preservation of material resources in the country.

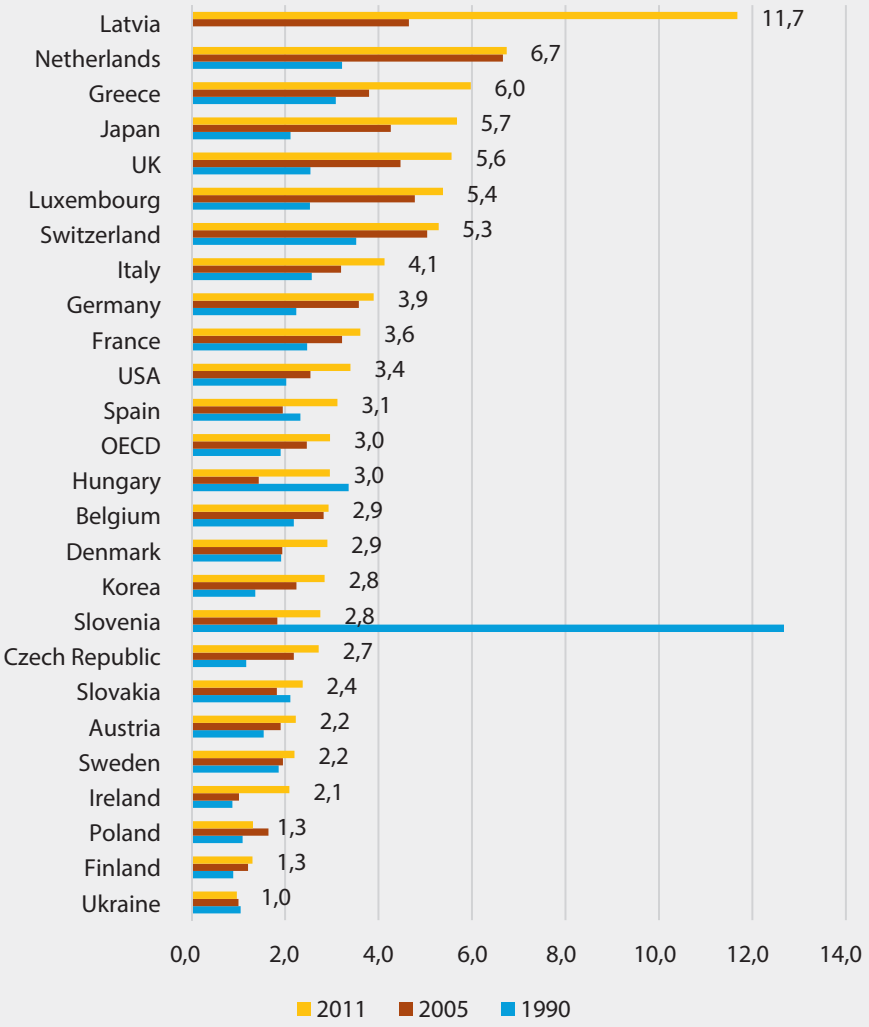
In 2011, the material productivity indicator calculated on the basis of GDP in US Dollars at PPP in constant 2010 prices was at 0.97 USD/kg – at least three times less than the OECD average (Figure 2.6) and

Figure 2.5. Dynamics of changes in material productivity of Ukraine's GDP, GDP growth rate and volumes of consumed materials, % (1990 = 100%)



Sources: State Statistics Service of Ukraine, 2015. Statistical Yearbook of Ukraine 2014;
Visualising Global Material Flows, http://www.materialflows.net/data/datadownload/.

Figure 2.6. Material (non-energy) productivity of GDP in OECD countries and in Ukraine, 1990-2011, USD/kg (numerical values in the graph refer to 2011)



Note: GDP in 2010 prices at PPP
Source: Sustainable Europe Research Institute, SERI, OECD GGI database.

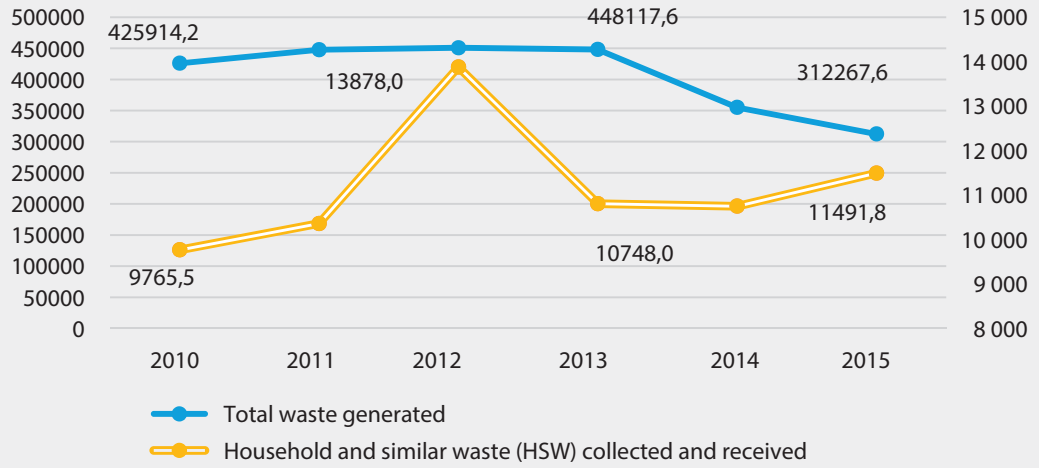
worse than in any of the countries Ukraine is compared with here. It is necessary to carry out a serious analysis of the causes of such a large gap with other countries based on the evaluation of resource efficiency of enterprises in various sectors. Resource saving should be included in the list of top priorities of the government.

2.2.2. Waste management

GDP waste productivity is the relation of GDP in constant (2010) prices to the total volume of generated waste (or to the volume of household and similar waste), while GDP waste productivity index is the relation of the GDP index to the index of generated waste.

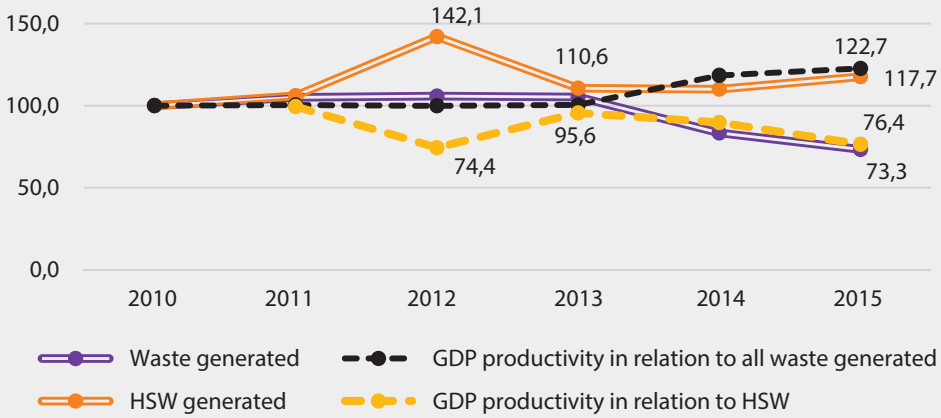
Utilisation and disposal of household and similar waste (HSW) remains an acute and urgent problem in Ukraine. While the total volumes of generated waste have been decreasing and the GDP per 1 kg of waste has been on the rise, the situation with household waste is quite different. In 2015, the volume of HSW collected and removed increased to 11.5 mln tons after a decrease from 13.9 mln tons in 2012 to 10.7 mln

Figure 2.7. Waste generation Ukraine in 2010-2015, thousand tons



Source: Waste generation in Ukraine in 1995-2015, http://ukrstat.gov.ua

Figure 2.8. GDP productivity in relation to total waste and to HSW (UAH/kg), indices of total waste generation and HSW generation in Ukraine, relative values, 2010=100 (%)



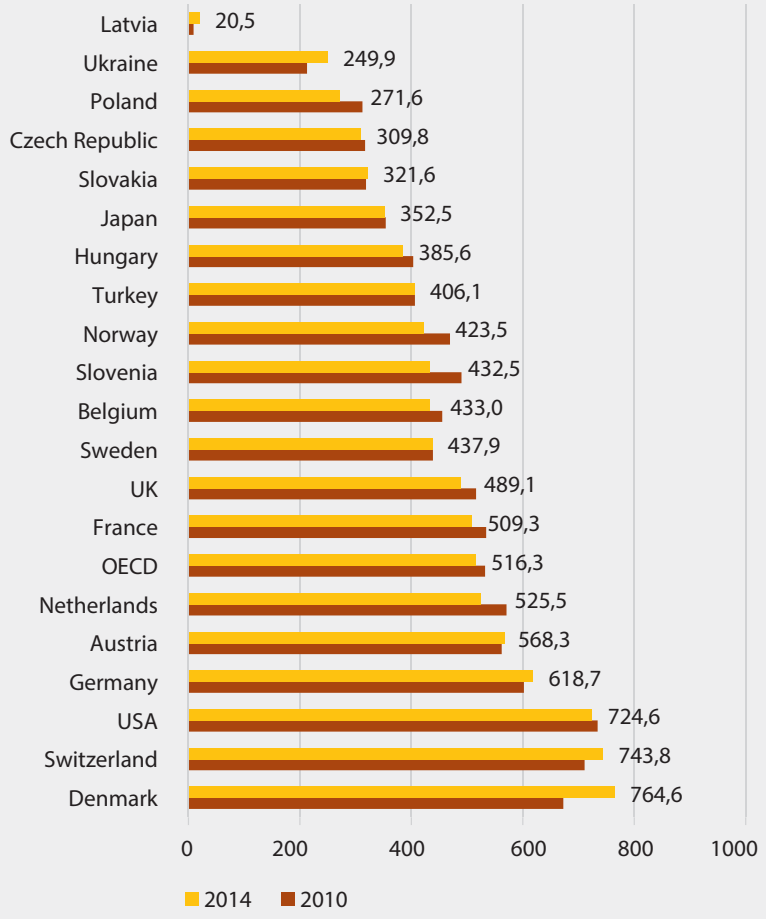
tons in 2014 (Figure 2.7). The share of utilization and landfilling total generated waste have been decreasing from 34.2% and 73.6% in 2010 to 30.8% and 57.4% in 2014 (29.6% and 48.8% in 2015), but the share of wastes destined for incineration with energy recovery and for other method of removal increased from 0.2% and 5.7% in 2010 to almost 0.3% and 10% in 2014 (0.35% and 18% in 2015). GDP productivity in relation to HSW is diminishing accordingly (Figure 2.8).

In Ukraine, only 78% of the population are provided with HSW removal services, and there are not enough plants for HSW processing. Overall, household waste remains one of the country's most pressing economic and environmental problems conditioned by such factors as the underdevelopment of the waste reuse infrastructure, weak coordination at the operational level, etc.

Although the per capita volume of household waste generated in Ukraine is lower than in most OECD countries (in 2014 it amounted to 249.9 kg, see Figure 2.9), the lack of infrastructure for waste recovery, recycling and disposal remains a serious challenge.

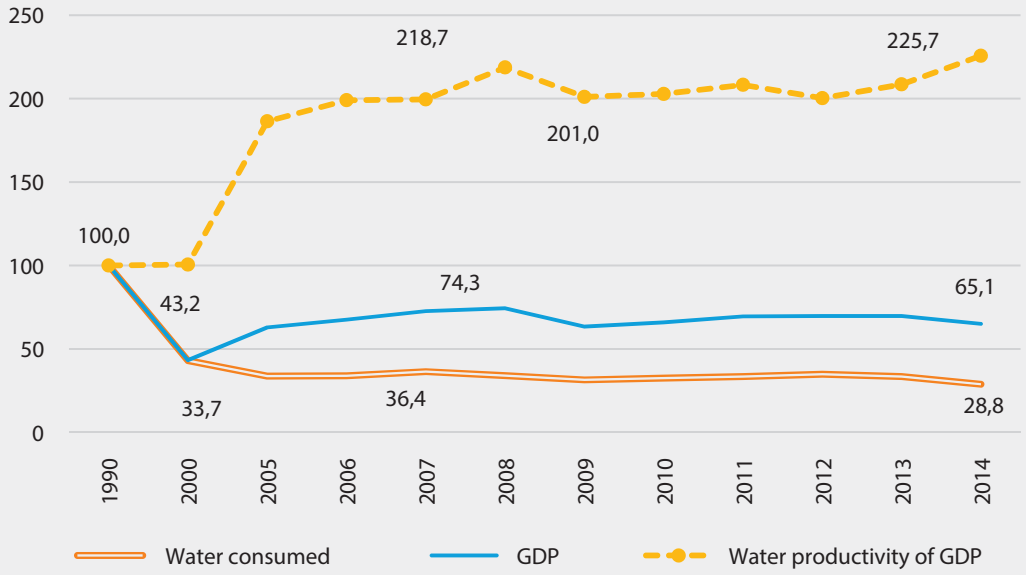
The Strategy of the State Environmental Policy of Ukraine until 2020 requires a 1.5-fold increase in the volumes of waste collection, utilisation and reuse by 2020 over the 2010 figure and a 15% decrease in the generation of biodegradable waste.

Figure 2.9. Volumes of municipal waste generated in OECD countries and of household and similar waste generated in Ukraine on the per capita basis in 2010-2014, kg (numerical values in the graph refer to 2014)



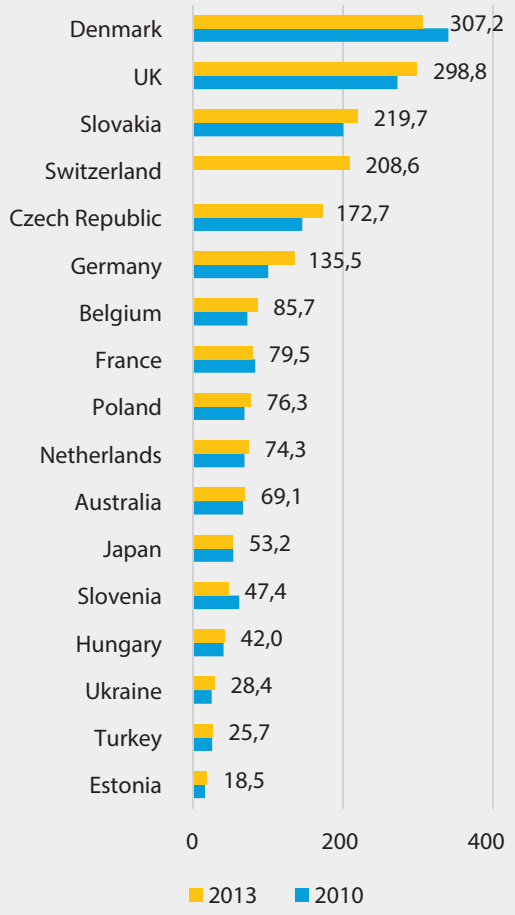
Source: Waste generation in Ukraine in 1995-2015, http://ukrstat.gov.ua/; Green Growth Indicators, http://stats.oecd.org

Figure 2.10. Indices of GDP, water consumption and GDP water productivity in Ukraine in 1990-2014, relative values, 1990=100, %



Source: calculated by the authors of the report based on *Main indicators of water use and water resources protection*, http://ukrstat.gov.ua/

Figure 2.11. Water productivity of GDP (in constant 2010 prices, at PPP) in OECD countries and Ukraine in 2010-2013, USD/m³ (numerical values in the graph refer to 2013)



Sources: calculated by the authors of the report using *Freshwater abstractions* (million m³), http://stats.oecd.org; *Green Growth Indicators*, http://stats.oecd.org; *Main indicators of water use and water resources protection (1990-2015)*, http://ukrstat.gov.ua; State Statistics Service of Ukraine, 2015. *Statistical Yearbook of Ukraine 2014;* GDP, USD, constant prices, constant PPPs, reference year 2010, millions, *http://stats.oecd.org/*

2.2.3. Water productivity of GDP

Water productivity of GDP is the relation of GDP in constant (2010) prices to the total volume of consumed water, while the GDP water productivity index is the relation of the GDP index to the corresponding index of water consumption.

In 1990-2014, the water productivity of Ukraine's GDP grew almost 2.3 times: from 54.3 UAH/m³ in 1990 to 123.9 UAH/m³ in 2014 (Figure 2.10).

Diminishing water consumption and growing water productivity are partly due to the decrease in population, the downturn in economic activities and industrial production, a more economical consumption of water through the widespread installation of water meters and a wider use of drip irrigation.

In 2014, the main water users were industrial enterprises (thermal and nuclear power plants, metallurgy and coal mining), agriculture, housing and utility services.

Reductions in water consumption led to a GDP water productivity growth not only in Ukraine, but also internationally (Figure 2.11).

2.2.4. Balance of humus and nutrients

In Ukraine, data on humus and nutrients content are based on the monitoring of soils by way of farmland surveys undertaken every 5 years for mineral substances and annually for humus.

Soils and their condition are the main and most powerful component of the environment, one of the foundations of life and a key factor in ensuring food security of the country. Agricultural performance largely depends on the state of the soil cover.

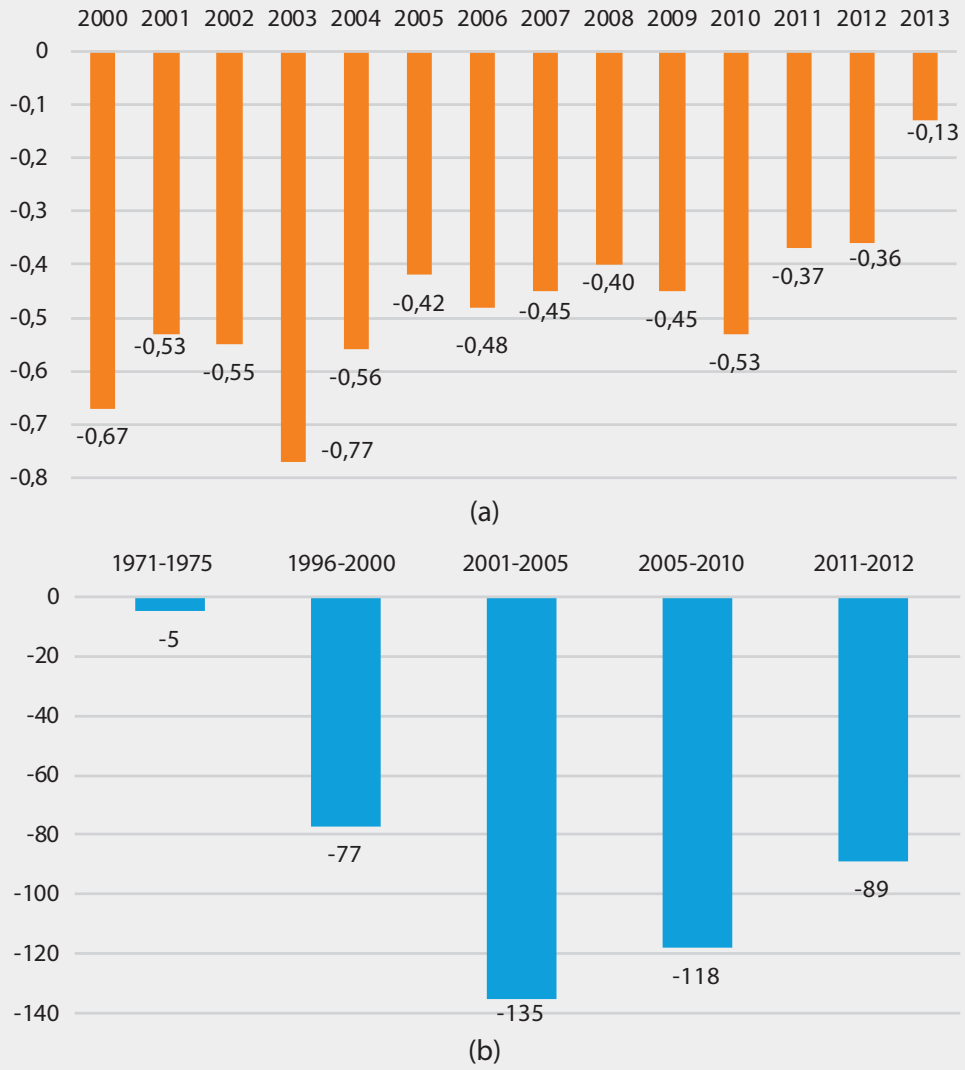
In 2000-2010, the quality of soils in Ukraine deteriorated: both the humus stock and the content of nutrients went down (Figure 2.12).

The balance of nutrients reached its minimum in 2001-2005 (-135 kg/ha) and slightly increased by 2011-2012, but this growth did not offset the overall negative balance.

Among the main factors reducing soil fertility today are low levels of mineral (Figure 2.12) and, especially, organic fertilisers input.

In 2004-2014, Ukrainian farms and agricultural enterprises applied less than 1 ton of manure per ha, while the minimum level ensuring a deficit-free balance of humus in Ukraine amounts to 8-14 t/ha. The main reason for this is the decline of animal husbandry resulting in the lack of organic fertilisers.

Figure 2.12. Balance of humus (a) and nutrients (b) in Ukrainian soils, t/ha



Source: Ministry of Ecology and Natural Resources of Ukraine, 2015. National report on the state of the environment in Ukraine in 2013.

On the contrary, the application of mineral fertilisers has been growing – from 51.4 tons/1000 ha of phosphorus and nitrogen fertilisers in 2010 to 70.2 tons/1000 ha in 2014, even though these fertilisers remain in short supply in Ukraine.

In terms of phosphorus and nitrogen fertilisers' input per 1000 ha, Ukraine is close to such OECD countries as Italy, Hungary and Slovakia (Figure 2.13).

2.3. Indicators of availability and utilisation of natural resources

2.3.1. Land resources

The structure of land resources is calculated as the proportion of each type of land in the country's total area.

Ukraine occupies an area of 60,354.9 thousand ha, or 0.4% of Earth's surface, of which land area amounts to 57,928.5 thousand ha. Ukraine possesses 8.7% of global reserves of black earth (chernozem), 2.3% of arable land (8th place in the world) and 2.2% of global cereal acreage. The structure of Ukraine's land resources is shown in Figure 2.14.

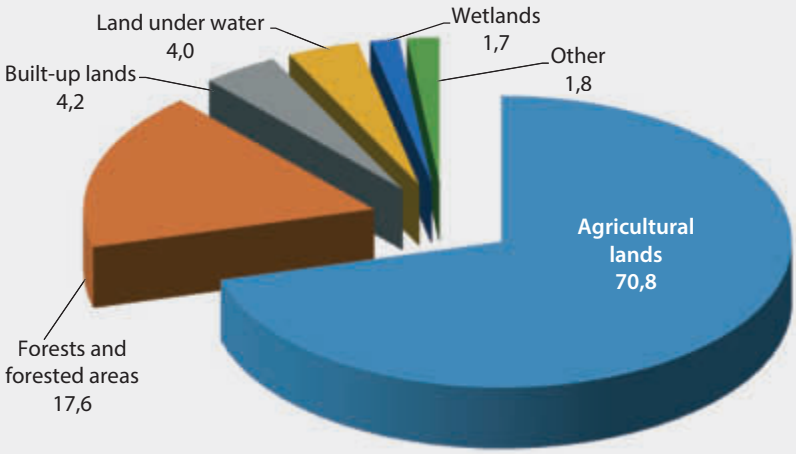
Figure 2.13. Input of phosphorus and nitrogen fertilisers in OECD countries in 2002 and 2010 and in Ukraine in 2002 and 2014, t/1000 ha (numerical values in the graph refer to 2013)

Sources: based on Agri-Environmental Indicators – Fertilizers, http://faostat3.fao.org/compare/E
Dataset: Land use, http://stats.oecd.org/Index.aspx?DataSetCode=LAND_USE
State Statistics Service of Ukraine. Application of mineral and organic fertilisers in corresponding years, http://ukrstat.gov.ua/

Ukraine belongs to the group of countries with the highest proportion of agricultural land in the total area of the country – 70.8% in 2014, including: farmland – 68.8%, ploughland – 53.9%, pastures and hayfields – 13.0%. However, the area of pastures is steadily decreasing: in 2014 they covered 5,441 thousand ha (9.0% of Ukraine's territory) against 5,521 thousand ha in 2000. The area of pastures in Ukraine is definitely not the smallest in the world, but in many countries their share is much higher (Figure 2.15 (b)), while the proportion of plough land in Ukraine exceeds that of many OECD countries (Figure 2.15 (a)).

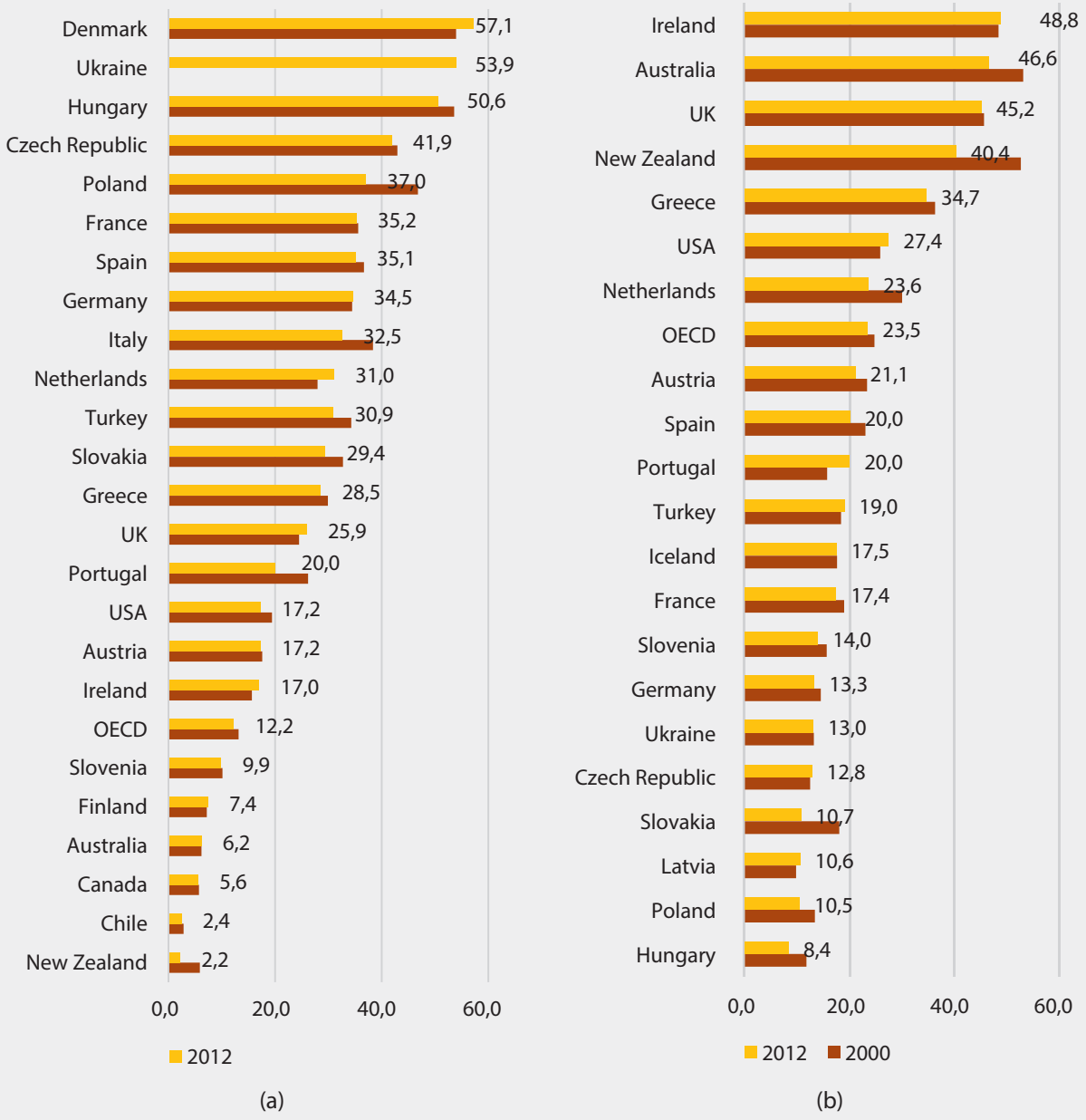
The level of ploughing of Ukrainian lands is increasing at the expense of diminishing pastures, which leads to microclimatic changes, affects the groundwater level, triggers the processes of aridisation and desertification, water and wind erosion. The situation is further aggravated by a decrease in soil fertility which affects not only environmental, but also food security, both nationally and globally. According to FAO estimates, the global food and feed demand in 2030–2050 will require a more than 60% increase in agricultural production compared to

Figure 2.14. Distribution of Ukraine's land resources in 2014, %



Source: State Statistics Service of Ukraine, http://ukrstat.gov.ua/

Figure 2.15. Area of ploughland (a), pastures and hayfields (b) in OECD countries and Ukraine in 2000 and 2012, % of the country's total area (numerical values in the graphs refer to 2012)



Sources: Land use, http://stats.oecd.org/Index.aspx?DataSetCode=LAND_USE;
State Statistics Service of Ukraine, 2012. *Agriculture of Ukraine. A Statistical Compendium.*

2006, which should be viewed in light of the fact that Ukraine provides 2.3% of global cereal output including 3.4% of global wheat and 22.8% of global sunflower.

The National Environmental Strategy of Ukraine covering the period until 2020 has set the task of reducing the ploughland area by 5-10%.

As of 01.01.2015, forests and forested areas covered 10,630.3 thousand ha, while the nature reserve fund of Ukraine had an area of 1,688.5 thousand ha, or 2.3% of the country's territory. This network of protected areas includes 19 nature reserves, 48 national parks and 4 biosphere reserves.

Of the total built-up land (2,542.6 thousand ha as of 01.01.2014), 29.3% is used for recreation and other activities, 19.5% for transport and communications, 19.0% for residential housing, and 8.8% for industrial purposes. Land used for residential development is the fastest growing segment.

2.3.2. Organic farming

Data on the area under organic farming are provided by the Federation of Organic Movement of Ukraine. The share of these lands in Ukraine's total territory is calculated accordingly.

In the European Union, organic production is defined as "an integrated management and food production system operating with due regard to the preservation of the environment and natural resources, the level of biodiversity, etc". Organic farming is farming system that avoids the use of artificial fertilizers, pesticides or herbicides and uses organic manure's and organic methods of crop rotation.

In Ukraine, the area of certified agricultural land under various organic crops already exceeds 400 thousand ha (Table 2.1). The share of certified organic farmland in Ukraine's total area has reached 0.39% which amounts to 0.97% of all agricultural lands.

Statistical reviews of the International Federation of Organic Agriculture Movements confirm that in 2014 the number businesses registered in Ukraine as "organic" reached 182 compared to just 31 in the beginning of 2003, while the total area of certified organic farmland amounted to 400,764 ha (Table 2.1).

Table 2.1. Area of organic farmland in Ukraine, 2002-2014

	2002	2004	2006	2008	2010	2012	2013	2014
Area, ha	164,449	240	242,034	269,984	270,226	272,85	393,4	400,764
% of total territory	0.27	0.40	0.40	0.45	0.45	0.45	0.65	0.66
% of agricultural land	0.39	0.57	0.58	0.65	0.65	0.66	0.95	0.97

Source: Organic in Ukraine: http://organic.com.ua/uk/homepage/2010-01-26-13-42-29

As to the structure of certified organic farmlands, 76.4% of them are ploughland, 21.3% – pastures, 1.8% – fallows, and 0.5% are used for perennial planting. Besides, 530,000 ha of wild crops in Ukraine are certified.

Ukraine ranks first among the countries of Eastern Europe by the area of organic ploughland, specialising in the production of cereals, grain legumes and oil crops, according to a report on Organic Farming in Ukraine.

According to Ukraine's Federation of Organic Movement, the domestic consumer market for organic products in Ukraine began to develop in the early 2000s and was valued at EUR 500,000 in 2007, EUR 600,000 in 2008, EUR 5.1 mln in 2011 and EUR 14.5 mln in 2014.

Alongside other priority goals, the 2020 agriculture development strategy aims at ensuring Ukraine's food security through the promotion of organic farming.

2.3.3. Forest resources

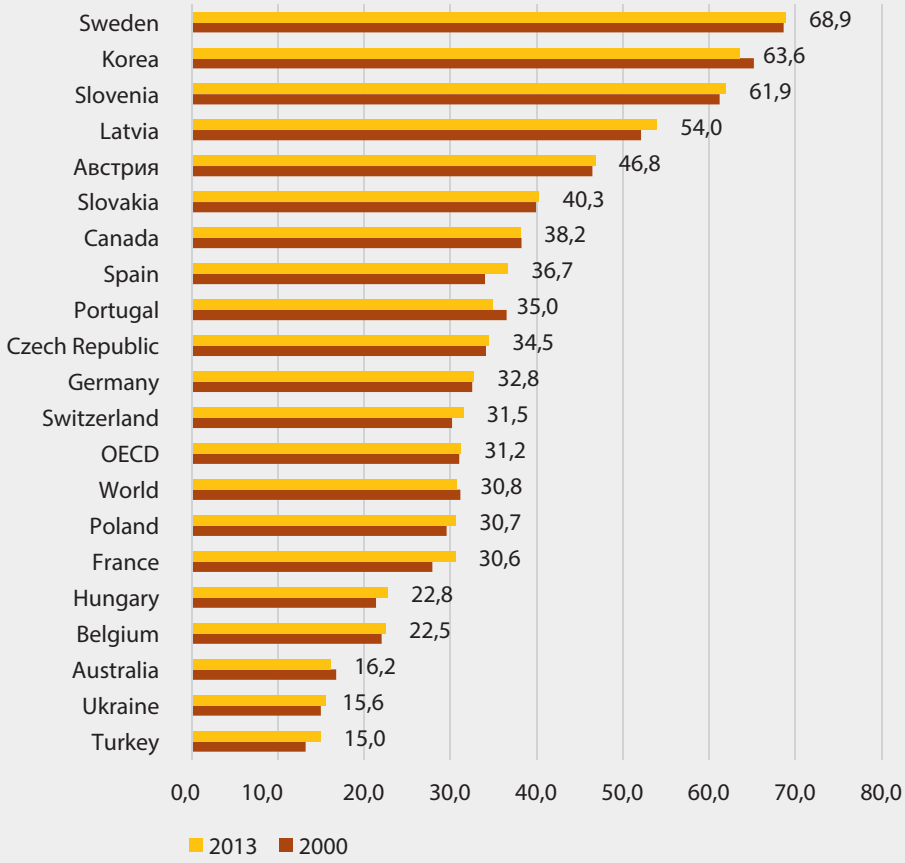
Availability of forest resources is calculated as the share of forests and forested areas in the total territory of the country.

By purpose and location, Ukrainian forests for the most part perform water-protection, land-protection, sanitary and hygienic and recreational functions.

On the whole, forests and forestry are characterised by:

- the uneven distribution of forests and relatively low average level of forest cover in the south and east of the country;

Figure 2.16. Forest cover in OECD countries and Ukraine in 2000 and 2013, % of total territory (numerical values in the graph refer to 2013)



Source: Land use, http://stats.oecd.org/Index.aspx?DataSetCode=LAND_USE; State Statistics Service of Ukraine, 2015. Statistical Yearbook of Ukraine 2014.

- predominantly ecological functionality of forests and a high share of forests with restricted exploitation regime (up to 50%);
- the fact that half of Ukraine's forests are artificial and require special care.

As of 01.01.2015, the total area of forests and forested lands in Ukraine amounted to 10,630.3 thousand ha, of which 9,652.2 thousand ha were forested areas. Compared with OECD countries and international indicators, Ukraine has a lower availability of forest resources with 15.6% of forest cover – compared to the global average of 30.8% and 31.2% in OECD countries. By European standards, an optimal forest cover indicator would be around 20% (as in the vast majority of OECD countries – Figure 2.16), and Ukraine is planning to achieve it by 2020.

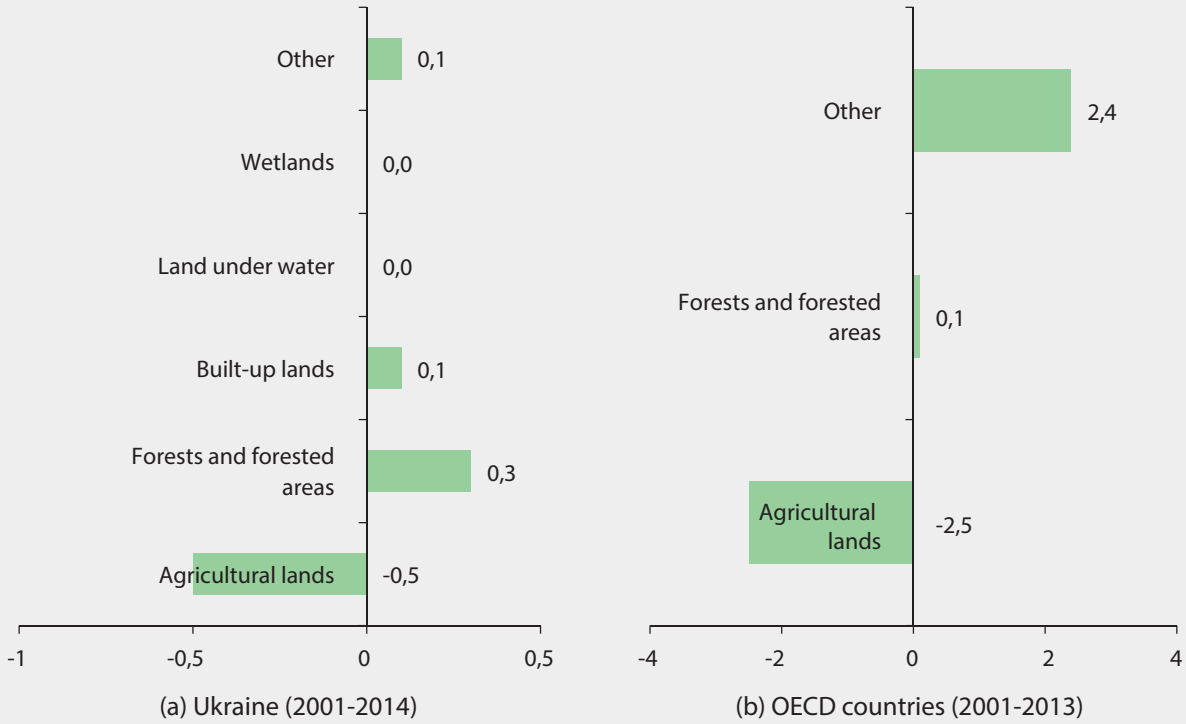
Timber stock in Ukraine's forests is estimated at the level of about 2,102 mln m^3; the average annual change in the standing forest crop per 1 ha is 4 m^3, ranging from 5 m^3 in the Carpathians to 2.5 m^3 in the steppe zone.

2.3.4. Land use changes

The land use change indicator is calculated as the difference between the shares of each land type in the country's total area in 2014 and 2001 (base year).

Figure 2.17 (a) shows the dynamics of changes in the use of Ukraine's land resources by main types of land and economic activities in 2014 compared to 2001.

Figure 2.17. Land use changes by types of land use, percentage points



Sources: Land use, http://stats.oecd.org/Index.aspx?DataSetCode=LAND_USE;
State Statistics Service of Ukraine, 2015. Statistical Yearbook of Ukraine 2014.

In 2001-2014, the area of agricultural land decreased by 308,000 ha: ploughland diminished by 6,000 ha, pastures shrank by 76,000 ha, while the area of hayfields remained unchanged.

By contrast, the area of built-up land increased by 101 thousand ha, with the lion's share of this increment accounted for by residential development. In 2014 alone, the area of land used for housing grew by 7.8 thousand ha. Forested areas expanded as well – by 204.1 thousand ha.

The area of forests in Ukraine has been growing faster than in OECD countries (Figure 2.17 (b)), but in OECD countries forests already occupy an average of 30.5% of the total area.

With a view to streamlining land use in Ukraine, it is proposed to improve the land management system and to optimise the balance between arable lands and those needed for ecological stabilisation, withdrawing degraded and low-yield lands from active use in order to ensure their conservation, rehabilitation and eventual transformation into forests and natural forage areas. Accordingly, the ploughland area will diminish by 8-10 million ha, while the share of forested and natural forage lands is expected to increase.

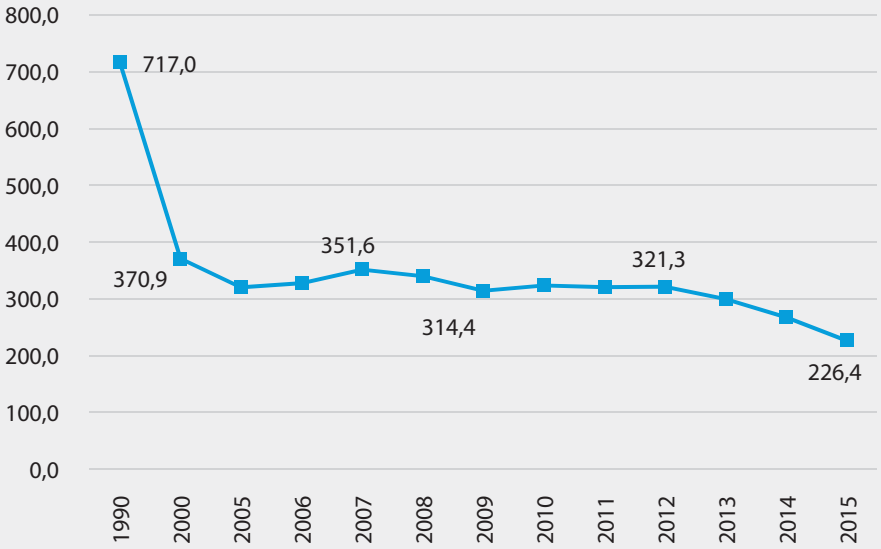
There are also plans to carry out land use monitoring on the basis of a set of indicators aligned with the EU criteria, indices and observation methods.

2.3.5. Water resources

Water resources are assessed by means of the indicator reflecting freshwater abstraction volume per capita (thousand m^3/person).

Ukraine's water resources include surface and ground waters. Surface water bodies cover 24.1 thousand km^2, or 4% of the country's total territory, and include rivers, lakes, water reservoirs, canals, ponds, etc. The most important of them are rivers numbering over 63,000, of which 9 are considered large and 87 – medium-sized.

Figure 2.18. Water abstraction per capita in Ukraine 1990-2015, m³/person



Source: based on Ukrstat data.

The Dnieper has the largest catchment area – 504,000 km², ranking third in Europe.

To provide both population and economy with water, 1,103 water reservoirs with the total volume of more than 55 bln m³ were built in Ukraine, along with 48 ponds and 7 large canals.

Ukraine's economy requires 15-16 bln m³ of water annually. Average multi-year renewable water resources are estimated at 95.2 bln m³, including 54.7 bln m³ of locally sourced water and 40.5 bln m³ of external inflow.

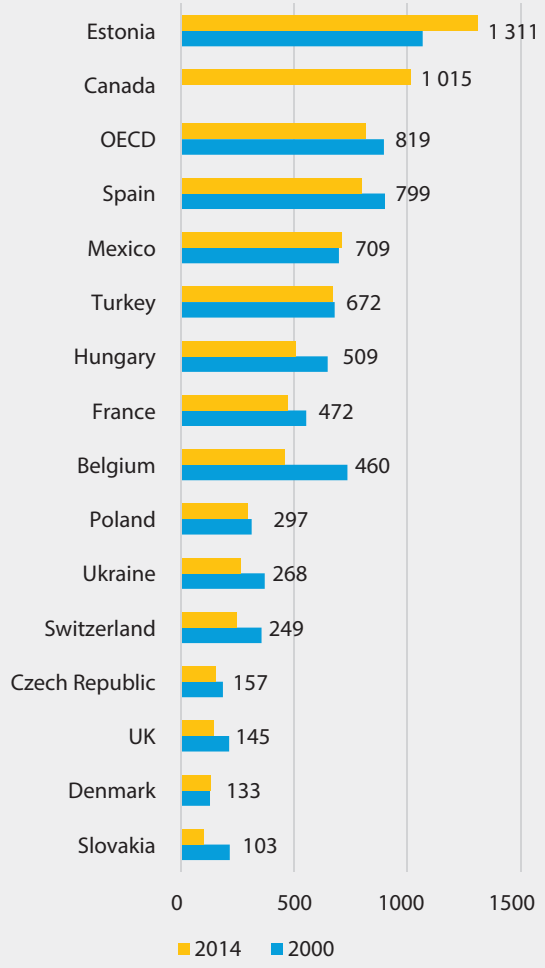
The total volume of estimated ground water resources amounts to 61,689.2 thousand m³/day or 22.5 bln m³/year, of which 57,499.9 thousand m³/day is water with salinity up to 1.5 g/dm³. The availability of drinking groundwater resources is estimated at 1.3 thousand m³ per person per day, on average.

By international standards, Ukraine is a water-deficient country with an uneven distribution of water resources.

In 1990-2014, water abstraction per capita decreased by a factor of 3.2 (Figure 2.18), hitting the lowest level in 2014 when the volume went down almost by 10.7%.

Ukraine's indicators of dependable water availability are close to those of Belgium, Denmark, Estonia, the Czech Republic and Poland, but are significantly lower than in other countries. In terms of per capita water consumption, Ukraine is on par with the group of OECD countries which use water sparingly (and for which relevant statistical data are available) (Figure 2.19).

Figure 2.19. Water abstraction per capita in selected OECD countries and Ukraine in 2000 and 2014, m³/person



Source: based on OECD statistic and Ukrstat data.

2.3.6. Non-renewable resources

Non-renewable resources are the reserves of hydrocarbons, coal, lignite, peat, metal ores, etc. They are assessed by extraction rate compared to the previous and the base year.

By global standards, Ukraine has a significant mineral and raw material base. To date, nearly 20 thousand deposits and manifestations of 95 types of mineral resources have been discovered; of these about 8000 deposits have commercial value and are included in the state register of useful mineral reserves. Ukraine ranks among the world leaders of proven reserves of iron, manganese and titanium-zirconium ores, as well as coal, graphite, china clay, potassium salts, sulphur, fire clays and face-stone. Thus, the country accounts for 7.5% of global coal reserves, 15% of all iron ores, and 42.8% of world manganese ore stocks [3]. The level of development of proven reserves varies from 40 to 100%.

At present, Ukraine extracts significant volumes of coal (1.7% of total global extraction), merchantable iron ores (4.5%), manganese ores (9%), uranium, titanium, zirconium, graphite (4%), china clay (18%), bromine, ochre, non-metallic metallurgical feed, etc. (Table 2.2).

In 2014, extraction of almost all mineral resources excluding china clay declined compared to 2013. The extraction of sulphur and potassium salts had been going down since the early 1990s and in 2007 was terminated altogether.

Table 2.2. Extraction of major resources in Ukraine in 2000-2014

	2000	2005	2007	2009	2011	2012	2013	2014
Oil and condensate, mln t		4.4	4.5	4.0	3.4	3.3	3.1	2.7
Natural gas, bln m^3	17.9	20.8	21.1	21.5	20.7	20.5	21.3	20.1
Coal, mln t	51.8	78.5	76.6	73.8	84.6	87.1	85.1	64.1
Iron ore, mln t	120.9	160.2	170.3	145.3	173.1	175.8	185.4	183.6
Manganese ore, mln t	6.7	5.6	5.8	2.7	1.4	1.2	1.5	1.5
Sodium chloride (salt), mln t		4.8	5.6	5.4	5.95	6.2	5.8	2.5
Bentonite clay, thousand t	145	312.6	314.1	195.1	210.8	218.5	256.5	178.4
China clay, mln t	1.3	1.9	2.4	1.4	2.1	2.1	2.1	2.5
Fire clay, mln t		6.5	7.8	3.2	7.1	7.4	5.7	6.3
Coalbed methane, mln m^3		-	-	52.3	17.2	9.5	8.2	6.2

Note: "-" – data is not available
Source: State Statistics Service of Ukraine.

2.4. Indicators of environmental aspects of the quality of life

2.4.1. Air pollution level and a population exposure to pollutants of $PM_{2.5}$ [4]

The level of air pollution is expressed as the level of emissions of major pollutants' and in relation to the population, expressed in tons per capita.

The state of the environment is an important factor affecting human health and well-being. Environmental degradation can have significant economic and social consequences – from increasing health care costs and decreasing agricultural production to disruptions in the functioning of ecosystems.

3 Ministry of Ecology and Natural Resources of Ukraine, 2016. National report on the state of the environment in Ukraine in 2014.
4 According to the World Health Organisation (WHO), exposure to fine particulate matter (PM2.5) has potentially the most significant adverse effects on health compared to other pollutants.

Air pollution is one of the main factors affecting human health and ecosystems. Despite a certain decline in production, which has triggered a reduced emissions of certain air pollutants, air pollution in Ukraine at present remains consistently high, especially in large cities and industrial centres.

Between 2010-2014, emissions of the most hazardous pollutants decreased as follows: nitrogen dioxide by 14%, soot by 10.8%, PM_{10} by 37.6%. However, increasing concentrations of fine particles, soot, NO_2 and toxic air pollutants have been a source of particular concern (Table 2.3).

Table 2.3. Emissions of the most hazardous air pollutants in Ukraine in 2010-2014, thousand tons

	2010	2011	2012	2013	2014
Sulphur dioxide	26.9	29.8	31.4	31.1	25.6
Nitrogen dioxide	603.7	633.0	634.6	633.4	520.6
PM_{10}	173.9	184.6	169.6	152.8	108.6
Soot	38.9	39.5	40.7	40.8	34.7
Non-methane volatile organic compounds	359.3	350.8	338.1	325.7	269.8
Ammonia	25.1	25.9	24.0	22.6	21.2

Source: State Statistics Service of Ukraine, 2015. The State of the Environment in Ukraine: a statistical compendium.

With a relatively small level of nitrogen dioxide emissions per capita (12.1 tons in 2014). Ukraine is on the same level with the three best positioned OECD countries regarding this indicator (Figure 2.20 (a)), it is on the same level with France and Germany in mean population exposure to $PM_{2.5}$ (Figure 2.20 (б)) and belongs to the group of leaders in terms of emissions of non-methane volatile organic compounds.

Compared to OECD countries, Ukraine has significant sulphur dioxide emissions per capita ranking alongside five OECD countries with the highest levels of this kind of pollution. These emissions contribute to acid rains and negatively affect people's health.

Ukraine complies with the requirements of the Montreal Protocol on substances that deplete the ozone layer and corresponding international commitments, participates in the regulation of the import and export of ozone-depleting substances and products containing them, and takes the necessary steps to align its legislation with the Montreal Protocol requirements and the EU acquis governing this area.

2.4.2. Air quality and health

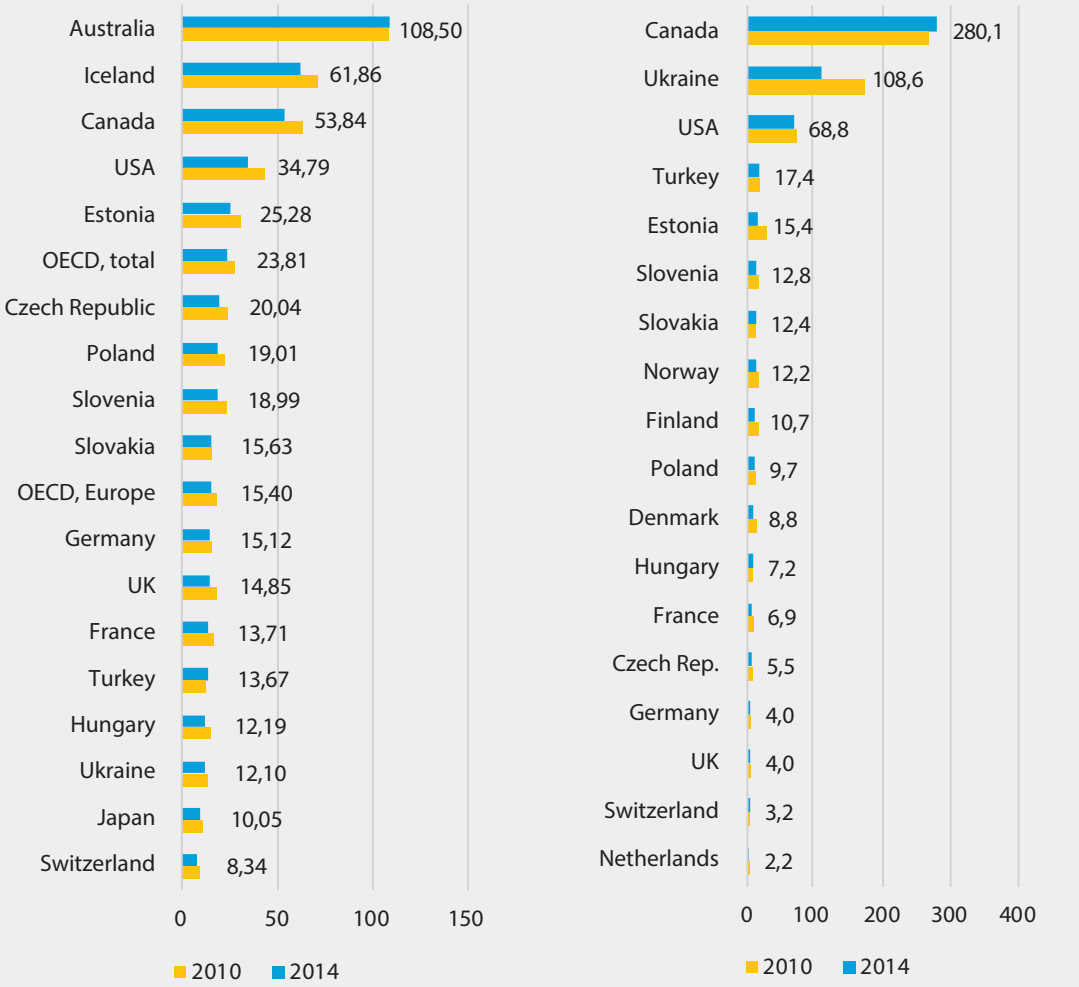
Human health is assessed by means of two indicators: life expectancy at birth (calculated by Ukrstat) and healthy life expectancy (calculated by WHO).

According to WHO experts, medical and demographic statistics consider health at the individual level as the absence of identified disorders and diseases, coupled with an overall decline in mortality, morbidity and disability levels.

Life expectancy is a summative indicator of mortality and the effect of all public health programmes, while healthy life expectancy is an indicator reflecting both mortality and morbidity/disability levels.

In Ukraine, the poor state of the environment, especially air pollution, causes an increase in morbidity and mortality. About 17 million people, or 34% of the total population, are negatively affected by polluted air. In cities with high pollution levels, child development defects occur 3-4 times more often than in relatively clean cities, respiratory diseases are registered twice as often, overall morbidity rate is 25-40% higher and levels of allergic, oncological and cardiovascular diseases are elevated accordingly.

Figure 2.20. Per capita emissions of nitrogen oxide and mean population exposure to $PM_{2,5}$ in OECD countries and Ukraine



(a) Per capita emissions of nitrogen oxide (kg per person) (numerical values in the graph refer to 2014)

(b) Mean population exposure to $PM_{2,5}$ (micrograms per m^3) (numerical values in the graph refer to 2014)

Sources: Dataset: Emissions of air pollutants. Data extracted on 08 Sep 2016 11:57 UTC (GMT) from OECD Stat., http://stats.oecd.org/Index.aspx?DataSetCode=GREEN_GROWTH;
Dataset: Exposure to PM2.5 in countries and regions. Data extracted on 14 Nov 2016 01:55 UTC (GMT) from OECD. Stat. http://stats.oecd.org/index.aspx?DatasetCode=EXP_PM2_5
State Statistics Service of Ukraine, 2015. The State of the Environment in Ukraine: a statistical compendium.

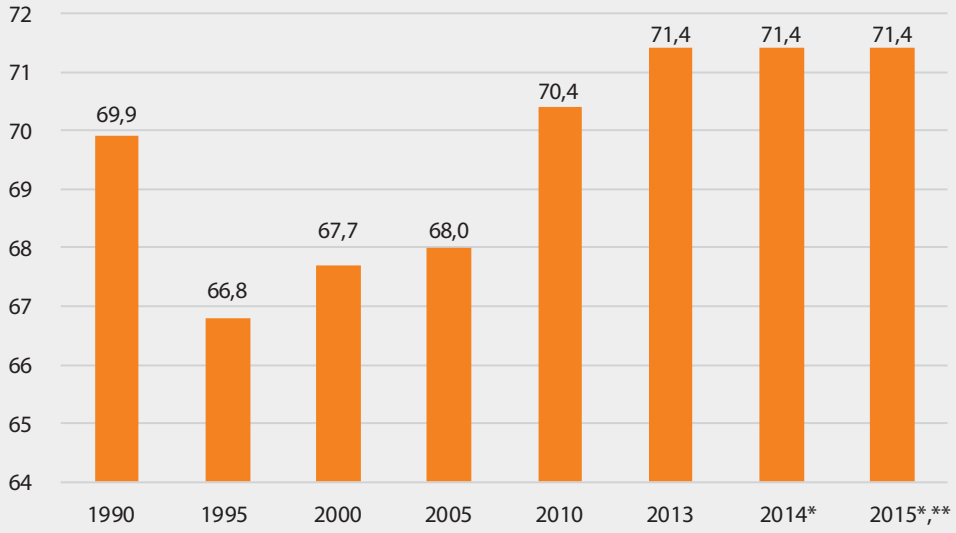
The circulatory diseases in Ukraine were recorded in 2015 – 194.2% compared to 1990; for skin diseases, this figure was lower – 105.4%. Only respiratory diseases had shown a downward trend, but their incidence level in Ukraine remains the highest among all diseases – 27,796 cases per 100 thousand inhabitants.

In 2015, life expectancy at birth in Ukraine was 71.4 years, having grown by 1.0 year compared to 1990; healthy life expectancy in the same year was estimated at 64.1 years (Figure 2.21).

According to WHO, since 2000 average life expectancy has been growing in most regions of the world; with the global average 5 years more than in 2015. Globally, life expectancy in 2015 was 71.4 years, reaching 80 years or more in 29 countries of the world. This indicator exceeds 83 years in Japan, Singapore and Switzerland; in 12 countries it is higher than 82 years [5]. Ukraine ranks last of all the countries shown in Figure 2.22 below.

[5] World health statistics 2016: monitoring health for the SDGs, sustainable development goals: http://www.who.int/gho/publications/world_health_statistics/en/

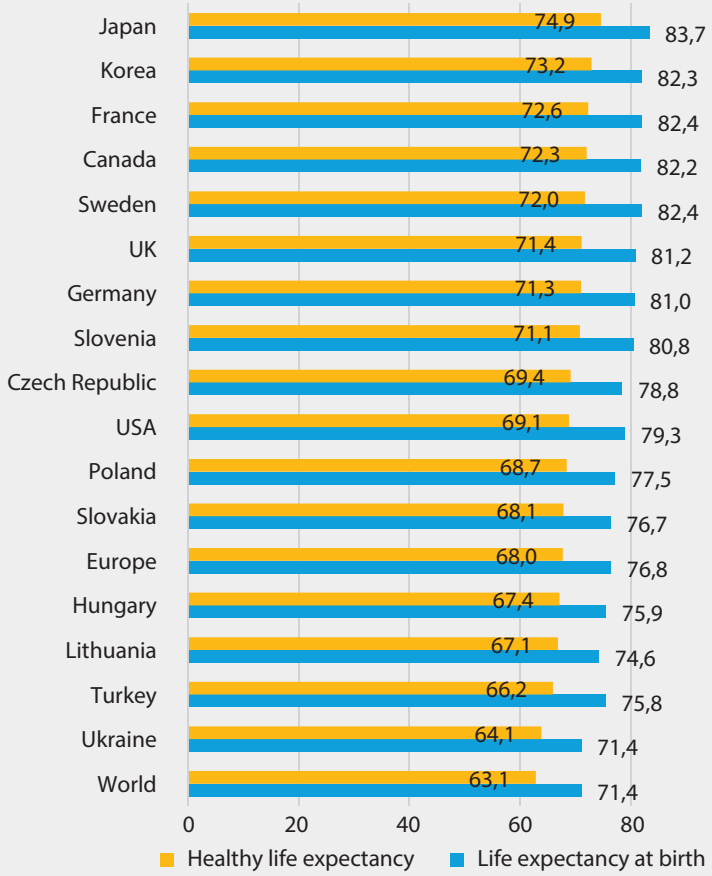
Figure 2.21. Average life expectancy at birth (number of years) in 1990-2015



Sources: State Statistics Service of Ukraine, 2015. Statistical Yearbook of Ukraine 2014;
State Statistics Service of Ukraine, 2015. Population of Ukraine in 2014.

* Exclusive of the temporarily occupied territory of the Autonomous Republic of Crimea, the city of Sevastopol and the area of ongoing antiterrorist operation;
** Exclusive of the data for Donetsk and Luhansk oblasts

Figure 2.22. Average life expectancy and healthy life expectancy in selected OECD countries, in the world and in Ukraine in 2015 (number of years)



Source: World health statistics 2016: monitoring health for the SDGs, sustainable development goals, http://www.who.int/gho/publications/world_health_statistics/en/

Globally, healthy life expectancy is on average 11.7% less than life expectancy, this gap varying from 9.3% to 14.7% in different countries (Figure 2.25). In Ukraine, this difference amounts to 7.2 years, or 10.1%. This is better than the international average and the figures for such highly advanced countries as the USA, Germany, France, UK, Sweden and Japan.

National strategic and policy documents have set the goal of increasing life expectancy in Ukraine by three years by 2020.

2.4.3. Access to water supply and improved sanitation facilities

For the purposes of this report, "water supply" means connection of living accommodations to water mains and "improved sanitation facilities" means access to a centralised sewerage system. Availability of water supply and sanitation facilities is assessed by the share of households serviced by water supply and sewerage networks in the total number of households in the country.

Two types of access to clean drinking water are considered in the present report:

- public access: water is available at a distance of not more than 100 m from each person;
- 24-hour access: connection to a water supply system.

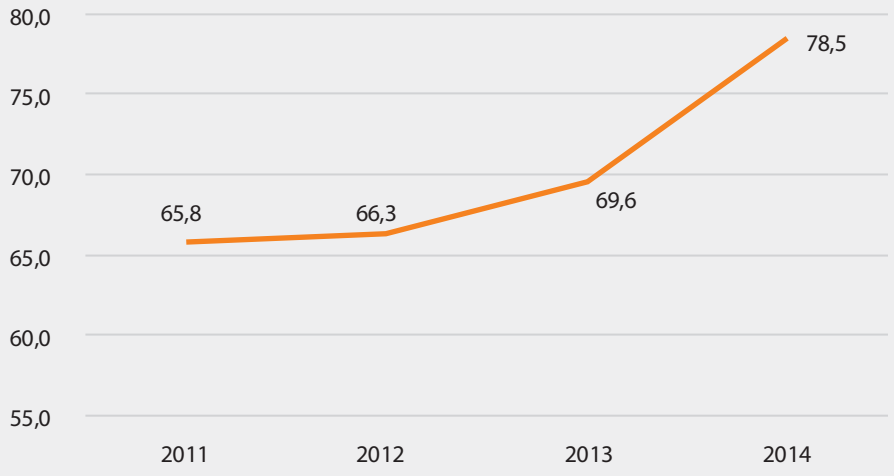
According to the World Bank, in terms of the public access, 96-97% of Ukraine's population is provided with water. This is better than the worldwide average (91%), yet it should not be forgotten that in many countries water supply services cover 100% of population.

In Ukraine, 78.5% of households are connected to water supply networks, although in rural communities this figure is only 26%.

Access to centralised sewerage systems is available to a lesser share of households. 12 towns and 345 urban settlements do not have centralised sanitation networks; only 4.4% of rural population are provided with wastewater and sewerage services.

In OECD, access to centralised sewerage varies from 63-65% (in Slovenia and Slovakia) to 100% in highly advanced countries, which means that Ukraine would behind.

Figure 2.26. Share of Ukrainian households connected to water supply networks in 2011-2014, % of total households



Source: calculated on the basis of Ukrstat data.

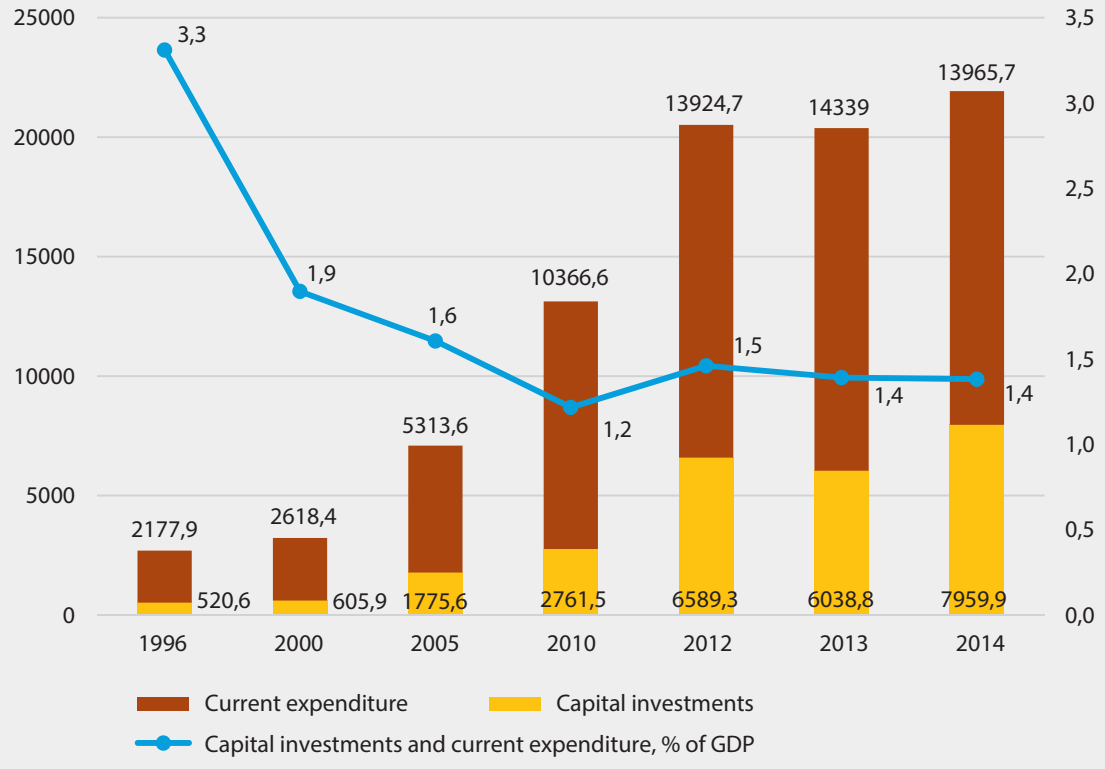
3. INDICATORS OF ECONOMIC OPPORTUNITIES AND POLICY RESPONSES

3.1. Capital investments and current expenditure on environmental protection financed by the state budget

In Ukraine, environmental protection expenditure amounted to almost 22 bln UAH in 2014, compared to 2.7 bln in 1996 (Figure 3.1), though in real terms, as % of GDP, it went down from 3.3% of GDP in 1996 to 1.4% in 2014. Current expenditure accounts for 63-81% of total funds appropriated for environmental protection purposes.

Besides, the share of state budget funds in capital investments declined from 7.5% of their total volume in 1996 to 0.5% in 2014, while the share of current expenditure financed by the state budget increased from 1.3% in 1996 to 2% in 2014.

Figure 3.1. Capital investments and current expenditure on environmental protection in Ukraine in 1996-2014, mln UAH and % of GDP (right-hand axis)

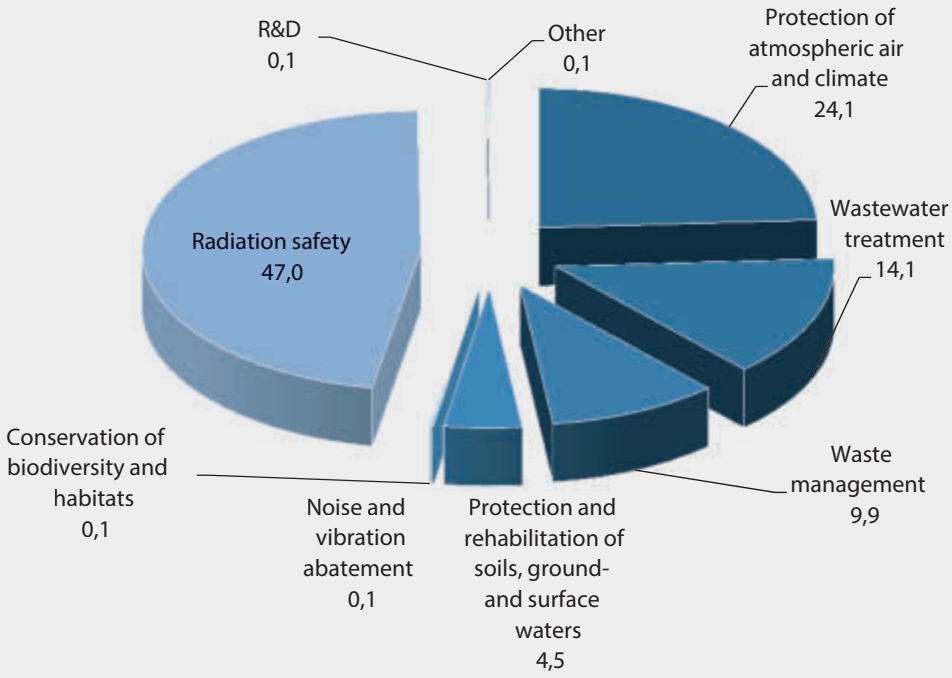


Source: State Statistics Service of Ukraine, 2015. Statistical Yearbook of Ukraine 2014.

In terms of structure, the largest share of capital investments was allocated to radiation safety measures, atmospheric air protection and wastewater treatment (Figure 3.2).

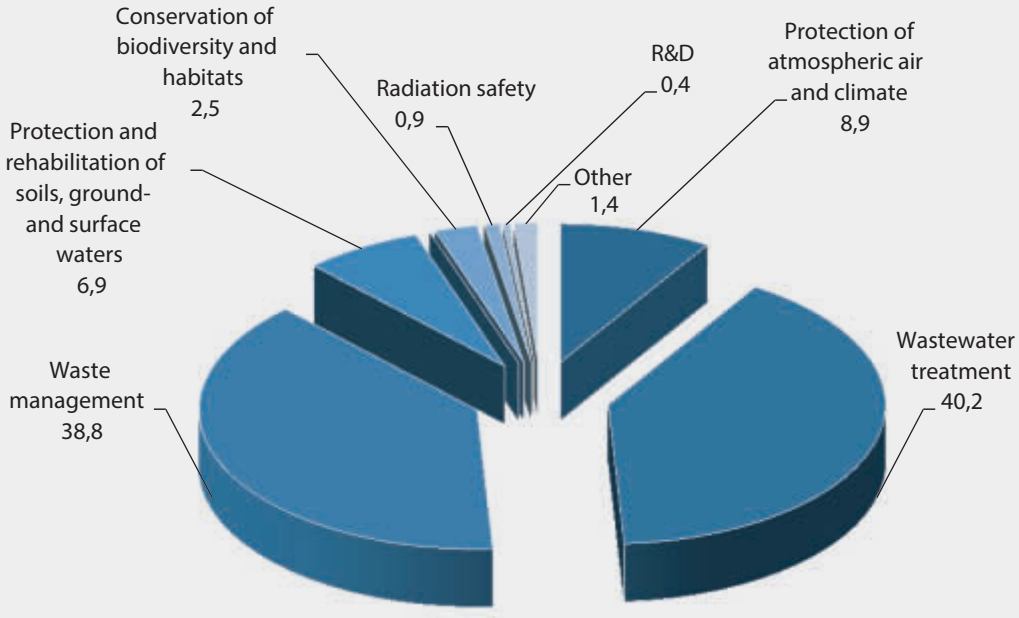
Current expenditure in 2014 was mainly channelled to wastewater treatment and waste management (Figure 3.3).

Figure 3.2. Distribution of capital investments by types of environmental protection activities in Ukraine in 2014, %



Source: State Statistics Service of Ukraine, 2015. Statistical Yearbook of Ukraine 2014.

Figure 3.3. Distribution of current expenditure by types of environmental protection activities in Ukraine in 2014, %



Source: State Statistics Service of Ukraine, 2015. Statistical Yearbook of Ukraine 2014.

Such distribution of funds is explained by the fact that in the last 10-12 years surface and ground water sources have been polluted by untreated wastewater discharges and now Ukrainian water sources are classified as belonging to categories III-V in terms of water quality.

The allocation of a significant share of current expenditure to the improvement of waste management contributed to the liquidation in 2014 of unauthorised dumps that had emerged because of the incomplete coverage of Ukrainian population with household waste collection and removal services.

3.2. Public funding of scientific research and innovations relevant to green growth

Information on the funding of scientific research and innovations from the state budget including public spending on research in support of the green growth is provided by the Ukrainian Institute for Scientific and Technical Expertise and Information (UINTEI) of the Ministry of Education and Science based on monitoring the results of activities in the areas of research and development, innovations and technology transfer. For the purposed of such monitoring, relevant data broken down by priority scientific, technical and innovation areas are provided by government agencies responsible for the administration of budget funds, in accordance with the Laws *On priority areas of scientific and technological development* and *On priority areas of innovation activities*.

There are four priority areas of scientific research and technological development contributing to green growth to larger extent:

- energy efficiency;
- sustainable use of natural resources;
- life sciences and new methods of prevention and treatment of the most common diseases;
- new substances and materials.

Of the seven strategic priorities defined by the Law *On priority areas of innovation activities in Ukraine* the following may be described as more contributing to green growth:

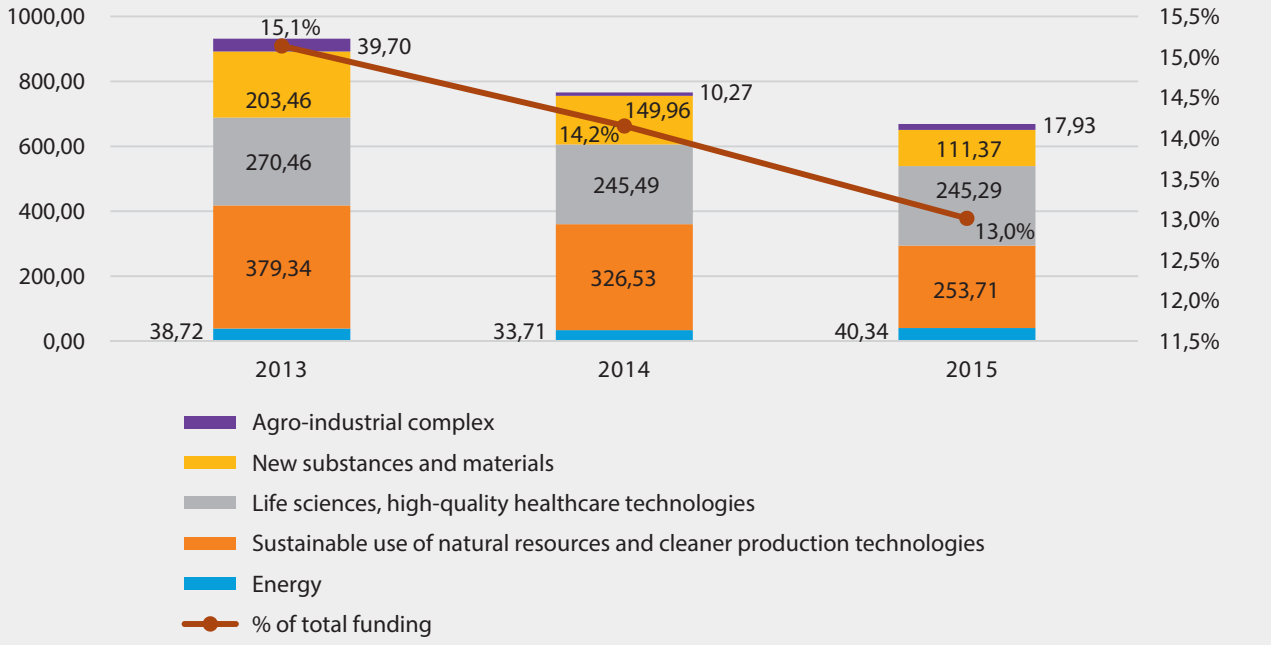
- development of new energy transportation technologies, introduction of energy-efficient and resource-saving technologies, development of renewable energy sources;
- development of new technologies for the production, processing and compounding of materials, creation of the nanomaterials and nanotechnologies industry;
- technological modernisation and development of the agro-industrial complex;
- widespread application of cleaner production and environmental protection technologies;
- introduction of new technologies and equipment for quality healthcare and medical treatment, as well as in the pharmaceuticals sector.

Within the framework of these strategic priorities, the Cabinet of Ministers has defined medium-term thematic priority areas for R&D and innovations-related activities.

According to the progress assessment of priority areas of scientific and technological development performed by UINTEI, the state budget expenditure on "green" scientific research and innovations in 2015 amounted to 5,138.5 mln UAH against 6,155.0 mln UAH in 2013, or 15.1-13.0% of the total budget allocations to science and innovations (Figure 3.4). On top of that, over the past three years the predominant share of expenditure was earmarked for scientific research which accounted for 96.4-97.5% of the total spending.

The funding of scientific research was for the most part channelled to such areas as sustainable use of natural resources and life sciences (Figure 3.5 (a)), while the funding of innovations concentrated on cleaner production and environmental protection technologies, as well as on modernisation and development of the agro-industrial complex (Figure 3.5 (b)).

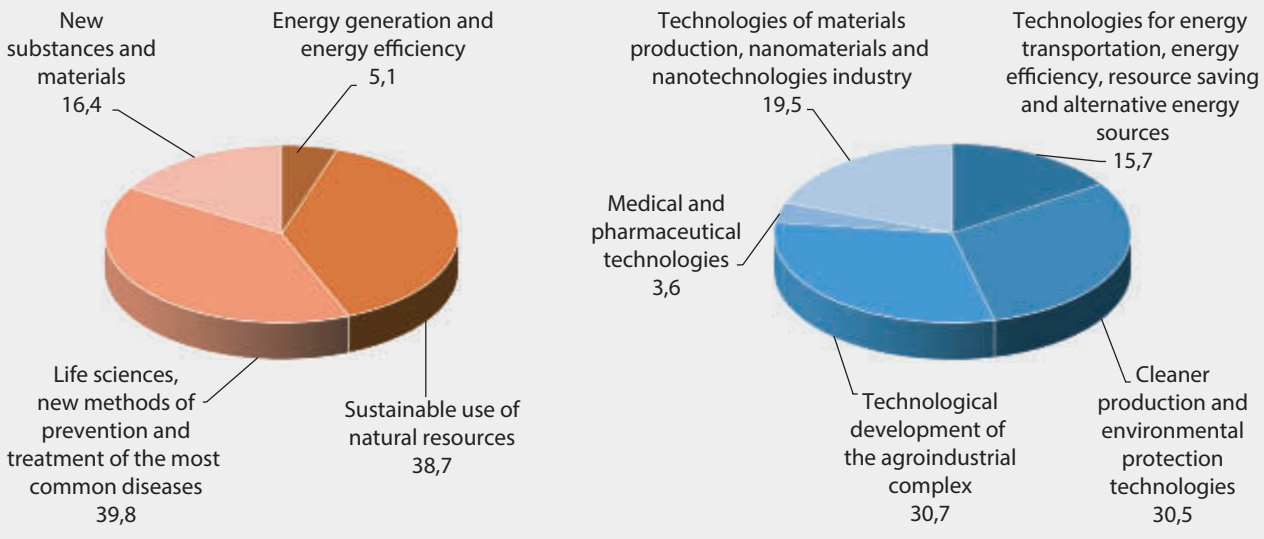
Figure 3.4. State budget expenditure on "green" scientific research and innovations in Ukraine in 2013-2015, in mln UAH and in % of the total public funding of scientific research and innovations (right-hand axis)



Note: Energy includes energy efficiency, resource saving technologies (energy saving technologies in the steel and chemical industries; energy efficient motors and drives for basic economic sectors, install heat pumps, solar collectors, teplosanatsiyi of houses and buildings budgetary institutions and etc.); development of renewable energy

Sources: calculated on the basis of data from *Analytical report. Progress in priority areas of science and technology development and results achieved in 2015; Analytical report. Progress in priority areas of science and technology development and results achieved in 2014; Analytical report. Status of science and technology development, results of scientific, technological and innovative activities and technology transfer in 2015.* http://mon.gov.ua/activity/nauka/informaczijno-analitichni-materiali.html.

Figure 3.5. Distribution of the state budget funds between "green" scientific research (a) and "green" innovations (b), % of total spending on "green" scientific research and "green" innovations



Source: see note to Figure 3.4.

4. SOCIO-ECONOMIC CONTEXT AND CHARACTERISTICS OF GROWTH

4.1. Economic growth and its structure

In 2001-2014, the average annual economic growth rate in Ukraine was 2.9%. In the crisis years of 2009 and 2014-2015, negative GDP growth rates were observed (Figure 4.1).

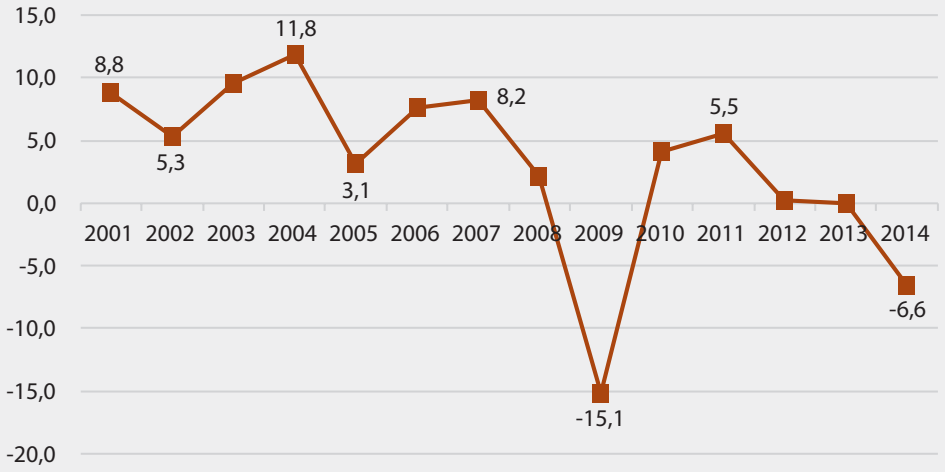
In 2001-2014, the structure of gross value added (GVA) in Ukraine changed reflecting an increase in the share of services and a decrease in the shares of industry, construction and agriculture (Figure 4.2), which is in line with trends dominating in developed countries. From an environmental standpoint this is a positive trend as the services sector consumes fewer resources and causes lower levels of environmental pollution.

Over 2001-2014, the contribution of agriculture, forestry and fishery to Ukraine's GVA decreased by 4.6 percentage points; the same indicator for industry was 7.2 and for construction – 1.2 pp.

4.2. Population

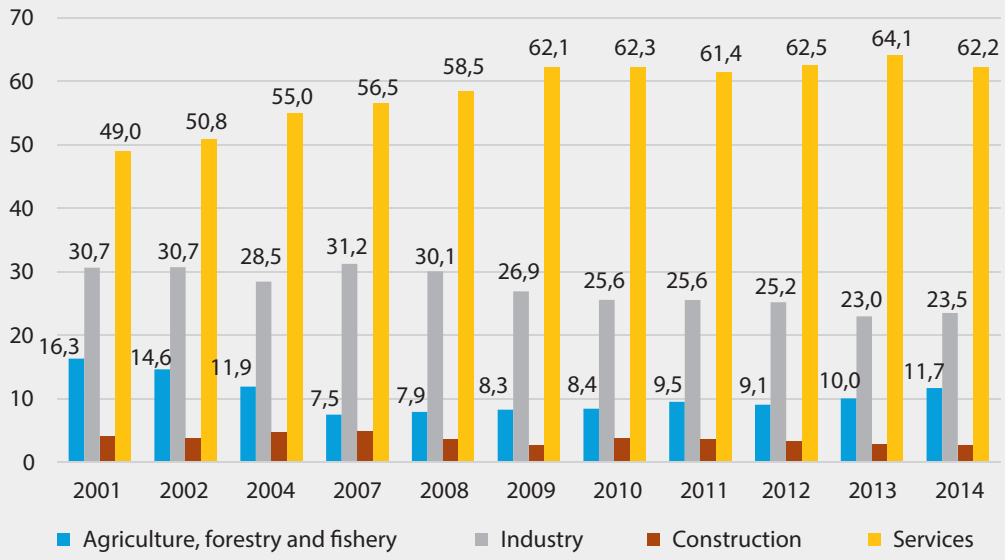
As of 01.01.2016, Ukraine's population was 42.8 mln (exclusive of the population of the Autonomous Republic of Crimea, the city of Sevastopol and the area of ongoing antiterrorist operation). Population decline began in 1990 and amounted to 17.2% over the period of 1990-2014. According to UN projections, this trend will

Figure 4.1. Annual GDP growth rates in Ukraine in 2001-2014, %



Source: based on Ukrstat data, http://ukrstat.gov.ua/

Figure 4.2. The structure of gross value added in Ukraine in 2010-2014, %



Source: based on Ukrstat data, http://ukrstat.gov.ua/

continue, outpacing a similar process observed in Europe: in 2015-2020, the expected annual shrinkage of the population will be at 0.52%, in 2020-2025 – at 0.61%, and up to 2050 thereafter – at 0.71% (Table 4.1).

Table 4.1. Population forecasts: the world, Europe and Ukraine, mln inhabitants

	2015	2025	2050
World	7,349	8,142	9,725
Europe	738	738	707
Ukraine	42.8	40	30

Source: World Population Prospects: The 2015 Revision. – New York: United Nations, Department of Economic and Social Affairs, Population Division, 2015 – http://esa.un.org/unpd/wpp/Graphs/1_Demographic%20Profiles/Ukraine/Population%20Pyramids/Population%20by%20Age%20in%201950.png

The current stage in Ukraine's development characterised by a decrease in the population of the most reproductive and economically active age. In the last 25 years, the country's working-age population (15-64 years) has been dwindling at an average annual rate of around 0.7%. According to UN forecasts, by 2025 it will diminish by another 11.5% compared to 2015 (the total population will decrease by 5.5%), and by 2050 – by 37.8% (21.7%)

In the opinion of some experts (Libanova E., 2014), depopulation as such is not likely to pose too much of a threat to Ukraine's labour market, as the shrinking of available manpower can be offset by labour productivity growth, although this will definitely require an adequate re-equipment of enterprises and changes in the education and vocational training systems.

The real threat is the high mortality level among working-age population. By 2025, the total number of inhabitants will decrease by 2.5 mln, while working-age population will shrink by 3.6 mln. This translates into a reduction in the total number of men by 1.1 mln (5.3 %) compared to 1.6 mln (by 10.4%) of working-age males, and a decrease of 1.3 mln (5.6%) in total number of women, with the ranks of working-age females diminishing by 2.0 mln (12.4%).

In line with the Lisbon goals, EU countries intend to raise their employment level to 70% by 2020, mainly by increasing the number of employed women, including those in senior age groups, up to 59% [6]. In this perspective, a high level of mortality among Ukrainian working-age female population should be seen as a threat to the country's labour market and pension system.

[6] The impact of ageing on public expenditure: projections for the EU25 Member States on pensions, healthcare, education and unemployment transfers (2004-2050) – http://europa.eu/epc/pdf/ageingreport_en.pdf

As of 2016, for each person aged 65 and older there were 4.3 working-age people (15-64 years). In 2000 this ratio was 1 to 4.9, and in 1990 – 1 to 5.6. In the future, the share of the elderly population (65 years and older) is projected to increase from 15.3% in 2015 to 18.4% in 2025 and to 23.3% in 2050.

Nevertheless, in Ukraine the "burden" of elderly population shouldered by working-age adults is smaller than the European average (3 working-age people per one person aged 65+ in 2025 and 2.1 in 2050) due to an abnormal difference between mortality rates in Europe and Ukraine, and within Ukraine – between female and male mortality levels.

4.3. Labour market

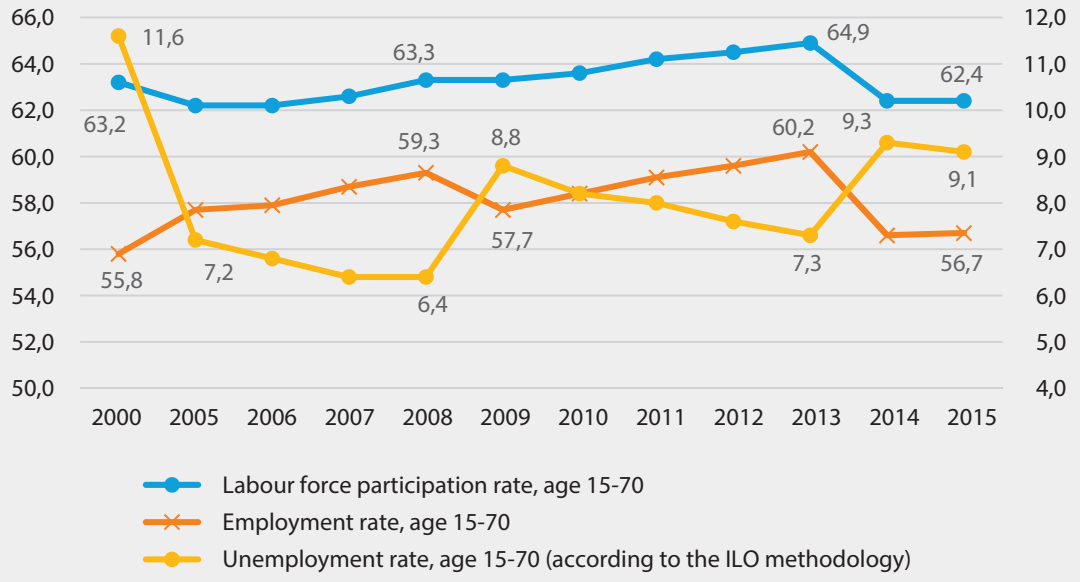
Over 2000-2015 in Ukraine, the level of the economic activity of the population aged 15-70 decreased by 0.8 percentage points and amounted to 62.4% (Figure 4.3), while for working-age people this figure was 71.5%. The highest level of the economic activity is observed in the 35-49 age group (85.1%), and the lowest – in the 60-70 age group (14.5%).

In the same period, the employment rate of the population aged 15-70 increased by 0.9 pp and reached 56.7% in 2015, while the employment rate of the working-age population was 64.7%. This indicator was at its highest in 2013, reaching 60.3%.

The highest employment rate is registered in the 35-49 age group (78.2%) and the lowest – in the 15-24 (28.2%) and 60-70 (14.5%) age groups.

Unemployment rate (as per ILO methodology) for people aged 15-70 declined from 11.6% in 2000 to 9.1% in 2015, with substantial fluctuations within this period. Unemployment increased in the crisis years of 2009 (financial crisis) and 2014 (commencement of hostilities in Ukraine's East), followed by stabilisation and subsequent downturn. Although being high, in Ukraine this indicator is lower than the average unemployment rate in EU countries (9.4%).

Figure 4.3. Labour market in Ukraine in 2000-2015, %



Source: Ukrstat data, http://ukrstat.gov.ua/
The 2010-2015 data are exclusive of the temporarily occupied Autonomous Republic of Crimea and the city of Sevastopol; the 2015 data are also exclusive of a part of the area of ongoing antiterrorist operation.

In 2015, the unemployment rate among working-age population was at 9.5%. The highest unemployment rate is characteristic of young people aged 15-24 (22.4%), and the lowest – of the population aged 50-59 (6.3%).

At the end of 2015, the number of registered unemployed people per 10 vacant jobs was 189. Ukraine's problem is the structural disproportion between labour demand and labour supply which limits employment opportunities for the unemployed and restricts the availability of manpower for employers. In 2015, skilled toolworkers and professionals of the retail and services sectors were in the highest demand, while occupations in least demand included agricultural, forestry and fishery workers.

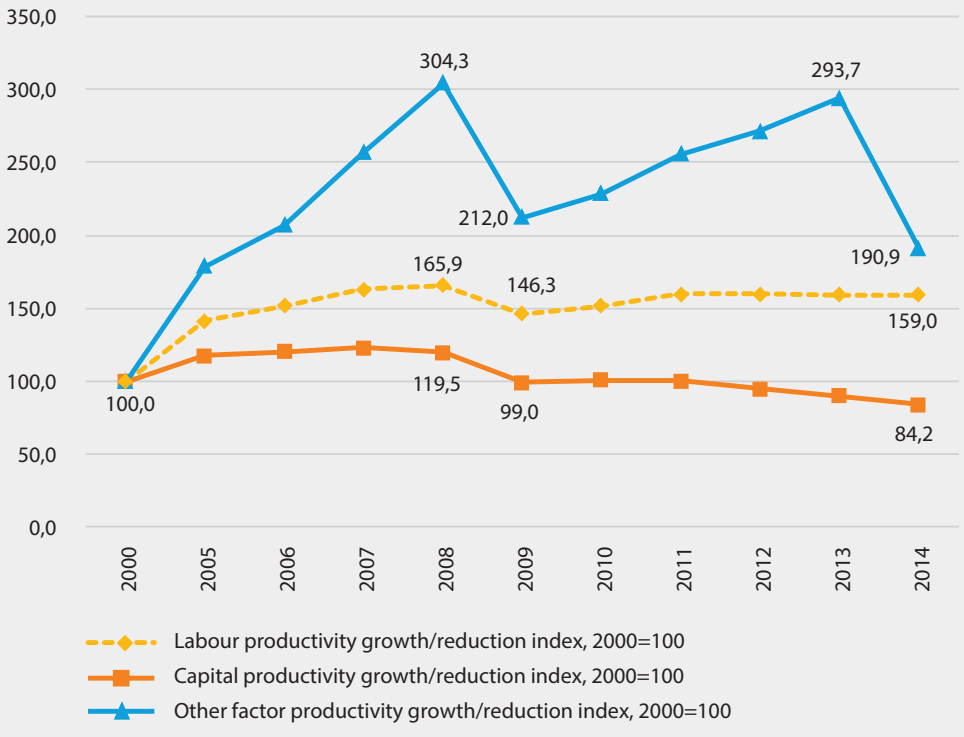
4.4. Multifactor productivity

In response to the depletion of traditional sources of economic growth and the need to ensure a more efficient use and expansion of the resource base and an increase in the number of jobs in order to improve the quality of life (or, at least, to avoid its deterioration), new approaches to sustainable development have evolved globally. They are based on the identification of as-yet-untapped potential for growth and include eco-innovations, efficient use of material resources, effective infrastructure, reduction in the generation waste and packaging materials and their reuse.

Resource productivity growth is made possible by the employment of new knowledge, application of new models of production of goods and services, development of state-of-the-art technologies and equipment, skills upgrades and a wider technology transfer. The contribution of these factors is assessed through the rate of changes in multifactor productivity (productivity of factors other than labour and capital).

To calculate multifactor productivity one needs to identify the component of the productivity index which is independent of changes in capital and labour and is formed through the use of new knowledge,

Figure 4.4. Labour, capital and multifactor productivity indices in Ukraine in 2000-2014, % (2000 = 100%)



Source: calculated by the authors of the report on the basis of Ukrstat data.

technologies and innovations. Traditionally, it is calculated residually and has been termed "the Solow residual".

In Ukraine, of the three types of productivity the multifactor component is growing the fastest: in 2014, it reached 190.9% of the 2000 level and exceeded the growth rate of labour and capital productivity by factors of 1.2 and 2.3, respectively (Figure 4.4).

In view of the fact that labour and capital productivity in Ukraine's industrial sectors remains low, multifactor productivity shows fairly good dynamics, mainly because of structural changes in the economy brought about by the growing share of the services sector, information and communications technologies and agriculture. However, its growth potential linked to energy- and resource-efficient technologies and wider application of environmental innovations and appropriate business models is far from being exhausted.

4.5. Indicators of the effectiveness of policy decisions

Governments play an important role in advancing their countries towards green growth by setting the framework for the promotion of sustainable production and consumption, encouraging the development and adoption of new technologies and innovations and improving the consistency of policy decisions. The effectiveness of such policies is best monitored by means of international indices and country ratings based thereon.

4.5.1. Ease of Doing Business Index

The doing business index assesses the degree to which the country's legal frameworks are favourable for business activities and ensure protection of property rights.

In 2016, Ukraine ranked 83-rd in the doing business rating, having improved its position by 13 points compared to 2015. Ukraine has simplified legal and regulatory procedures of starting a business and streamlined relevant legal frameworks. Pre-registration and registration formalities (publication, notarisation, inspection) have been simplified and on-line procedures improved. The time required for VAT registration has been reduced and the fee for registering a new business abolished (Table 4.2).

Table 4.2. Ukraine's rankings by components of the Ease of Doing Business Index in 2013-2016

Indicators	2013	Change	2014	Change	2015	Change	2016
Registration of businesses	50	*+3*	47	*-29*	76	+46	30
Dealing with construction permits	183	*+142*	41	*-29*	70	-70	140
Getting electricity	166	*- 6*	172	*+13*	185	+48	137
Registering property	149	*+52*	97	*+38*	59	-2	61
Getting credit	23	*+10*	13	*-4*	17	-2	19
Protecting minority investors	117	*-11*	128	*+19*	109	+21	88
Paying taxes	165	*+1*	164	*+56*	108	+1	107
Trading across borders	145	-3	148	*-6*	154	+45	109
Enforcing contracts	42	-3	45	*+2*	43	-55	98
Liquidation of businesses	157	-5	162	*+20*	142	+1	141

Source: Doing Business 2016: http://www.doingbusiness.org/~/media/GIAWB/Doing%20Business/Documents/Annual-Reports/English/DB16-Full-Report.pdf

According to *Doing Business 2016*, in Ukraine the registration of a business involves four procedures and requires not more than seven days.

4.5.2. The Global Competitiveness Index 2015-2016

Innovations and introduction of new technologies are among key factors of economic growth, and the dynamics of the *Innovations* and *Technological readiness* sub-indices within the Global Competitiveness Index (World Economic Forum) characterises the effectiveness of policy decision-making in this area.

In terms of the *Innovations* sub-index, in 2015-2016 Ukraine ranked 54th among 140 countries, having moved 27 positions up since the last publication of the rating (Table 4.3), with the largest gains in such components as *Capacity for innovation* (from 82nd to 52nd) and *Government procurement of advanced technological products* (from 123rd to 98th).

Table 4.3. The *Innovations* sub-index and its components, Ukraine's performance in 2013-2016

	2013-2014		2014-2015		2015-2016	
	Rank/148 countries	score (1-7)	Rank/144 countries	score (1-7)	Rank/140 countries	score (1-7)
Innovations	**93**	**3.0**	**81**	**3.2**	**54**	**3.4**
Capacity for innovation	100	3.2	82	3.6	52	4.2
Quality of scientific research institutions	69	3.6	67	3.8	43	4.2
Company spending on R&D	112	2.7	66	3.1	54	3.4
University-industry collaboration in R&D	77	3.4	74	3.5	74	3.5
Government procurement of advanced technological products	118	3.0	123	2.9	98	3.0
Availability of scientists and engineers	46	4.5	48	4.3	29	4.7
Number of patents registered in the USA per 1 million of the population	52	2.9	52	3.2	50	3.6

Source: The Global Competitiveness Report 2015-2016: http://www3.weforum.org/docs/gcr/2015-2016/Global_Competitiveness_Report_2015-2016.pdf

Table 4.4. The *Technological readiness* sub-index and its components, Ukraine's performance in 2013-2016

	2013-2014		2014-2015		2015-2016	
	Rank/148 countries	score (1-7)	Rank/144 countries	score (1-7)	Rank/140 countries	score (1-7)
Technological readiness	**94**	**3.3**	**85**	**3.5**	**86**	**3.4**
Availability of latest technologies	106	4.3	113	4.1	96	4.3
Firm-level technology absorption	100	4.3	100	4.2	100	4.2
Foreign investments and technology transfer	131	3.6	127	3.7	117	3.8
Individuals using Internet, %	93	33.7	82	41.8	80	43.4
Broadband Internet subscriptions/100 pop.	71	8.1	68	8.8	72	8.4

Sources: The Global Competitiveness Report 2014-2015: http://reports.weforum.org/global-competitiveness-report-2014-2015
The Global Competitiveness Report 2015-2016: http://www3.weforum.org/docs/gcr/2015-2016/Global_Competitiveness_Report_2015-2016.pdf

In the area of *Technological readiness* Ukraine ranks 86th out of 140 countries. Ukraine's ranking has declined due to the deterioration of performance vis-à-vis the *Broadband Internet subscriptions/100 population* indicator (the country moved down from the 68th to the 72nd place) – Table 4.4.

4.5.3. The Environmental Performance Index

The index is calculated based on the methodology of the Yale Center for Environmental Law and Policy and an analysis of statistical data performed by national and international organisations. The survey aims to reduce the pressure on the environment and, consequently, on human health, to support the resilience of ecosystems and to promote sustainable management of natural resources.

The index measures a country's progress in terms of the state of the environment and natural resources management by 22 indicators in 10 categories reflecting such aspects as the state of the environment and viability of ecological systems, combating climate change, public health status, the burden of economic activities on the environment, and the effectiveness of environmental public policies.

In 2016, the survey covers 180 countries. Ukraine ranks 44th between Cuba (45th) and Argentina (43th), outperforming Kazakhstan (69th) and Moldova (55th).

Compared to 2014, Ukraine's overall rank improved by 51 positions due to improvements in such sub-ratings as climate and energy, agriculture, water resources, public health, water and sanitation (Table 4.5).

4.5.4. The Sustainable Society Index

The Sustainable Society Index is an integrated indicator developed by the Sustainable Society Foundation and used to assess a country's progress in three major dimensions: economic, social and environmental.

The environmental part of the index includes two indicators, one of which, *Climate and energy*, is calculated based on four components: energy consumption, energy saving, greenhouse gases and renewable energy sources.

Table 4.5. Ukraine's rankings in the Environmental Performance Index in 2010-2016

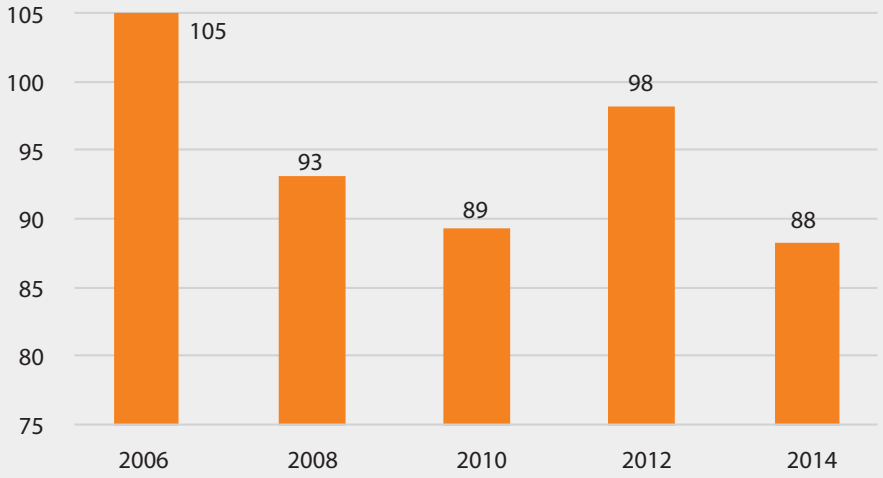
Subindex	2010		2011		2014		2016	
	Score	Rank	Score	Rank	Score	Rank	Score	Rank
Overall score	48.7	96	48.47	97	49.01	95	79.69	44
Health impacts	82.6	63	82.89	64	83.06	65	85.82	45
Air quality	82.54	84	80.9	88	84.76	71	84.18	76
Water and sanitation	65.29	61	65.31	62	65.31	62	87.22	61
Water resources	14.7	73	14.7	73	14.7	73	73.32	62
Agriculture	62.03	103	62.03	107	62.03	107	98.18	44
Forests	32.52	67	32.52	67	32.52	67	47.08	70
Fisheries	26.16	48	25.3	50	25.3	50	50.39	64
Biodiversity and habitat	41.46	119	41.46	119	41.46	119	65.58	130
Climate and energy	27.78	110	27.78	110	27.78	110	87.45	25

Source: The Environmental Performance Index: http://epi.yale.edu/country/ukraine

In the 2014 report, Ukraine ranked 88th in terms of the *Climate and energy* index, having improved its position in the overall ranking by 10 points (Figure 4.5).

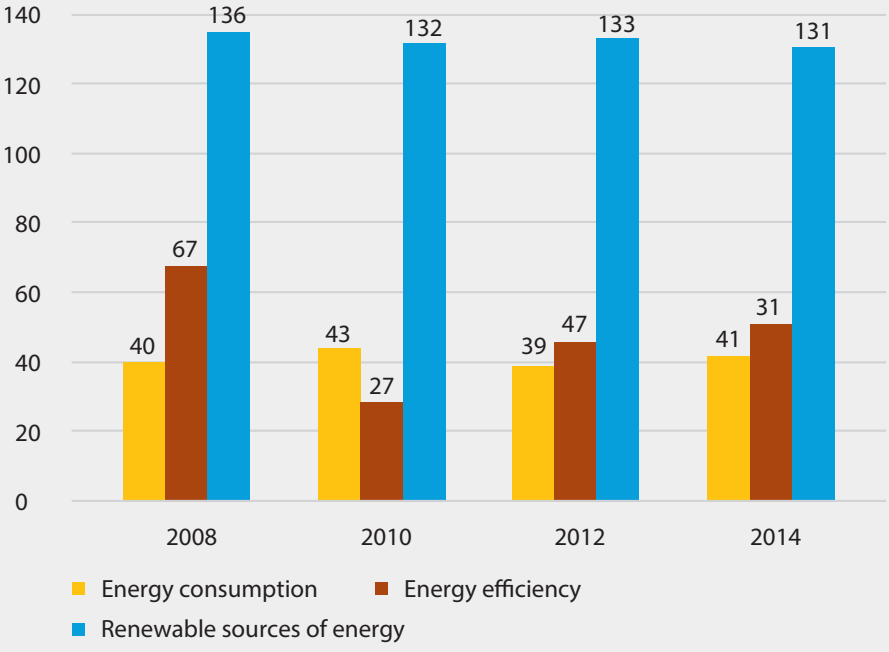
In *Energy consumption* Ukraine ranked 41st out of 151 countries in 2014, and 31st in *Energy efficiency*. The share of renewable energy sources in Ukraine's energy production remains insignificant, which ranks Ukraine 131st (Figure 4.6).

Figure 4.5. The dynamics of Ukraine's *Climate and energy* ranking



Source: The Sustainable Society Index 2014, http://www.ssfindex.com/ssi/

Figure 4.6. Changes in Ukraine's ranking in *Energy consumption*, *Energy efficiency* and *Renewable sources of energy*



Source: The Sustainable Society Index 2014, http://www.ssfindex.com/ssi/

Annex 1
Results of the analysis of applicability of OECD green growth indicators in Ukraine

No	OECD-proposed indicators by themes	Applicability in Ukraine (+full compatibility; ≈ partial; – not applicable)	Proposed changes for Ukraine
I	**Indicators of environmental and resource productivity**		
I.1	***Carbon and energy productivity***		
I.1.1	Production-based carbon productivity of GDP, USD/t CO_2: GDP per unit of CO_2 emissions of the energy sector	+	–
	GDP in constant 2005 prices, at PPP, USD		
I.1.2	Index of energy-related CO_2 emissions, 1990=100	+	–
I.1.3	CO_2 emissions of the energy sector per capita, t CO_2/person	+	–
I.1.4	Energy productivity of GDP: GDP per unit of energy used, USD/1000 toe	+	–
	GDP in constant 2005 prices, at PPP, USD		
I.2	***Energy intensity of GVA by types of economic activities***		
I.2.1	Energy intensity of the manufacturing industry and transport – MJ/USD of GVA	≈	Energy intensity of industry, transport, households, thousand toe/UAH of GVA
	GVA in constant 2010 prices		
I.2.2	Share of renewable energy (geothermal, solar, wind, tide, wave and ocean, generated from waste), % of energy consumed	+	–
I.2.3	Share of renewable energy (geothermal, solar, wind, tide, wave and ocean, generated from waste) in total energy generated, %	+	–
I.3	***Material productivity of GDP (non-energy materials)***		
I.3.1	Index of domestic consumption of non-energy materials, 1990=100	≈	Index of domestic consumption of non-energy materials, 2000=100
I.3.2	Material productivity of GDP, USD/kg	+	–
	GDP per unit of non-energy materials consumed by the country		
	GDP in constant prices at PPP in USD (base year 2010)		
I.3.3	Index of municipal waste generation, 1990=100	≈	Index of waste generation, 2010=100 Note: waste of I-IV hazard classes, generated by households and through economic activities of enterprises and organisations

No	OECD-proposed indicators by themes	Applicability in Ukraine (+full compatibility; ≈ partial; – not applicable)	Proposed changes for Ukraine
I.3.4	Intensity of waste generation per unit of GDP or GVA	+	–
	GDP in constant prices at PPP in USD (base year 2010)		
I.3.5	Volume of waste generated per 1 inhabitant, t/person	+	–
I.4	***Resource productivity***		
I.4.1	Balance of nutrients in agriculture, % to the previous year	≈	Balance of nutrients in agricultural lands
I.4.2		*Additional indicator*	Productivity of agricultural lands: GVA in agriculture / area of farmlands, UAH/ha (GVA in constant 2010 prices)
I.4.3		*Additional indicator*	Share of organic produce in total agricultural production, %
I.4.4	Water productivity of GDP, including:	+	–
	Water productivity of GVA in industry, agriculture, housing and utility services, USD/m^3	≈	Water productivity of GVA in industry, agriculture, housing and utility service, UAH/m^3
	GDP (GVA) per unit of water consumed; GDP (GVA) in constant 2010 prices		
II	**Natural asset base**		
II.1	***Freshwater resources***		
II.1.1	Freshwater abstracted per 1 inhabitant, thousand m^3 /person	+	–
II.1.2	Water stress index, %	+	–
	Note: water stress is measured as the share of consumed freshwater in the total volume of available renewable resources of freshwater (including in-flows from neighbouring countries), %		
II.2	***Forest resources***		
II.2.1	Territory of forests and forested areas, % of the country's total territory	+	–
	Territory of forests and forested areas/territory of the country		
II.2.2	Territory of forests and forested areas per 1 inhabitant, km/1000 inhabitants	+	–
II.2.3	Index of changes in the territory of forests and forested areas, 1990=100	+	–
II.2.4	Territory of protected areas, % of the country's total territory	+	–
II.3	***Fishery resources***		
II.3.1	Fish capture and harvesting of other aquatic bioresources, mln tons	+	–
II.3.2	Share of fish capture and harvesting of other aquatic bioresources in the global volume, %	+	–
II.3.3	Index of fish capture and harvesting of other aquatic bioresources, % to 1979-1981	≈	Index of fish capture and harvesting of other aquatic bioresources, % to 2000

No	OECD-proposed indicators by themes	Applicability in Ukraine (+full compatibility; ≈ partial; – not applicable)	Proposed changes for Ukraine
II.3.4	Share of exploited fish stocks in available biological resources	–	–
II.4	***Land resources***		
II.4.1	Lands of agricultural designation,	+	–
	ploughland,		
	pastures,		
	built-up land,		
	% of the total territory		
II.4.2	Land use changes in each category compared to 1990	+	–
	Unit of measurement – share of each land use category		
	Calculated as the difference between the share of each category in year t compared to the corresponding share in 1990		
II.5	***Animal resources***		
II.5.1	Trends in abundance or population size of farm or game animals, poultry or forest birds, fish	+	–
II.5.2		+	–
II.5.3		+	–
II.5.4	Share of critically endangered (threatened) mammals, birds, fishes, vascular plants in their overall (known) quantity, %	–	–
II.5	***Non-renewable resources***		
II.6.1	Stocks of extractable resources	–	–
II.6.2	Extraction growth rates, % to the previous year	+	Extraction growth rates – coal, lignite and peat, %
			Extraction growth rates – oil and natural gas, %
			Extraction growth rates – metal ores, %
III	**Environmental aspects of the quality of life**		
III.1	***Environment-related health issues***		
III.1.1	Air quality – ozone pollution, microgram per m^3/day, starting from 70 **µg** per m^3/day	+	–
III.1.2	Air quality – air pollution by particulate matter, **µg** per m^3/day	+	–
	Note: particles less than 10 micrometres in diameter		
III.1.3	Share of the population affected by air polluted by sulphur dioxide, nitrogen, nitrogen oxide, carbon oxide, methane, soot and ozone (O_3), % of total population	≈	Incidence of circulatory diseases, number of new cases per 100,000 population
III.1.4			Incidence of malignant neoplasms, new cases per 100,000 population
III.1.5			Incidence of respiratory diseases, new cases per 100,000 population
			Incidence of digestive diseases, new cases per 100,000 population

No	OECD-proposed indicators by themes	Applicability in Ukraine (+full compatibility; ≈ partial; – not applicable)	Proposed changes for Ukraine
III.2	***Population with access to water supply and improved sanitation facilities***		
III.2.1	Share of the population with access to a centralised municipal sewage system, % of total population	+	–
III.2.2	Share of the population with access to improved water supply sources, % of total population	+	–
IV	**Economic opportunities and policy responses**		
IV.1	***Technological development and innovations***		
IV.1.1	Public and private expenditure on "green" R&D (energy- and environment-related research), % of total R&D funding and corresponding public expenditure	≈	R&D funding in the area of technical sciences, % of the total funding
IV.1.2	"Green" R&D funding from the state budget, % of total R&D funding	+	–
IV.1.3	"Green" R&D funding by the private sector, % of total R&D funding	+	–
IV.1.4		*Additional indicator*	Funding of "green" innovations from the state budget in total public funding of innovation activities, %
IV.1.5	Share of innovation-active enterprises regularly involved in activities aimed at reducing pressure on the environment and attainment of "green" development goals and motivated towards eco-innovations, % of the total number of innovation-active enterprises	≈	Share of innovation-active enterprises in "green" sectors in the total number of innovation-active enterprises "Green" types of industrial economic activities have the following codes: KVED-2005: 37, 41; KVED-2010: 22, 36-38, 39.
IV.1.6		*Additional indicator*	Share of sales from innovative products produced in green sectors ("green types of industrial economic activities") in the total volume of innovative industrial products sales in Ukraine, %
IV.2	***Production of environmental goods and services***		
IV.2.2	Share of "green" enterprises in the total number of the country's enterprises, % Note: "green" enterprises – codes ISIC 25.12; ISIC 37; ISIC 41	+	–
IV.2.3	Gross value added in "green" industrial sectors, % of GDP Note: "green" sectors – ISIC 25.12, 37, 41, 90	+	–
IV.3	***Prices and transfers – environmental payments***		
IV.3.1	Revenues from environmental taxes, % of total tax revenues	+	–

No	OECD-proposed indicators by themes	Applicability in Ukraine (+full compatibility; ≈ partial; – not applicable)	Proposed changes for Ukraine
IV.3.2	Structure of environmental taxes by types of taxes, % of total environmental taxes	≈	Structure of environmental taxes by types of taxes, % of total environmental taxes
			on atmospheric pollution
			on discharging pollutants directly into water bodies
			on waste disposal in specifically allocated locations or sites
IV.4	***Financial flows***		
IV.4.1	Public expenditure on Rio+20 goals: climate action, prevention of biodiversity loss and desertification, carbon markets, gas trade, reduction of greenhouse gas emissions, etc., % of GDP or GNI	≈	Amount of capital investments and current expenditure from the state budget appropriated to environmental protection, % of GDP
IV.4.2	Foreign direct investments (FDI) related to green growth goals: % of total FDI received during the current year; % of GDP	+	–
V	**Socio-economic context and characteristics of growth**		
V.1	***Economic growth and its structure***		
V.1.1	Index of real GDP, 1990=100 Note: based on GDP in 2010 constant prices at PPP	+	–
V.2	***GDP structure***		
V.2.1	Share of agriculture in total GVA, % (including hunting, forestry and fish farming)	+	–
V.2.2	**Share of industry in total GVA**, % Industry – types of economic activities coded ISIC 10-45, include extractive and manufacturing industries (ISIC 15-37), production of electricity, gas and water, construction	≈	Share of industry in total GVA, % (includes extractive and manufacturing industries, production of electricity, gas and water) Ukrstat
V.2.3			Share of construction industry in total GVA, % Ukrstat
V.2.4	**Share of services in total GVA, %** Services including trade, operation of hotels and restaurants, transport, public sector activities, financial, professional and private services in such areas as education, healthcare and real estate, as well as banking services, statistical services, services related to collection of custom duties, etc.	+	–
V.2.5	Changes in the average share of agriculture in the country's GVA over the last three years compared to the corresponding share in 1990-1992	+	–

No	OECD-proposed indicators by themes	Applicability in Ukraine (+full compatibility; ≈ partial; – not applicable)	Proposed changes for Ukraine
V.2.6	Changes in the average share of industry in the country's GVA over the last three years compared to the corresponding share in 1990-1992	+	–
V.2.7	Changes in the average share of services in the country's GVA over the last three years compared to the corresponding share in 1990-1992	+	–
V.3	***Population density and the burden on working-age population***		
V.3.1	**Population density**, inhabitants/km^2	+	–
V.3.2	The burden of senior-age population on working-age people: population aged 65 and older in proportion to population aged 20-64	+	–
V.4	***Labour market***		
V.4.1	Unemployment rate, %	+	–
V.5	***Productivity***		
V.5.1	**Labour productivity**, average values of GDP per 1 person employed for 1995/2000 and 2000/2011, average annual growth rate, % GDP in 2010 prices at PPP	+	–
V.5.2	**Multifactor productivity in the economy as a whole**, calculated as the difference between the GDP growth rate and the growth rate of inputs (labour and capital for the economy as a whole)	≈	Multifactor productivity in the economy as a whole, calculated as the difference between the GDP growth rate and the growth rate of inputs (labour and capital for the economy as a whole)
V.6	***Inflation and consumer price index***		
V.6.1	Inflation and consumer price index, 1990=100	≈	Consumer price index, 2000=100 Ukrstat
V.6.2	Consumer price index for food products, 1990=100	≈	Consumer price index for food products, 2000=100 Ukrstat
V.6.3	Consumer price index for energy, 1990=100		–
V.7	***Socio-demographic parameters***		
V.7.1	**Years of healthy life:** number of years (on average) that a person may live "in the full of one's health", taking into account years spent in imperfect health because of illnesses and/or traumas	≈	Life expectancy at birth (number of years) Ukrstat
V.8	***Inequality level***:		
V.8.1	Gini coefficient	+	–

[1] ISIC – UN International Standard Industrial Classification of all Economic Activities (http://unstats.un.org/unsd/cr/registry/regcst.asp?Cl=17

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