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ENERGY FOR A GREEN ECONOMY

1. Introduction

Energy is one of the key factors determining the development of human civilization. It affects practically every aspect of social and economic development, determines the functioning of particular households and societies, production in agriculture, industry, transport and all kinds of services including health care, education and water supply. Access to electrical energy enabled job creation and significant improvement of the life standards for whole populations. Energy is a starting point for achieving every simple goal of sustainable development around the world: social equity, economic growth and environmental protection.

Current patterns of energy production and consumption have direct negative impact on the environment and natural resources at the local, regional and global levels. In many places a high level of local air pollution, soil and water acidification are directly associated with the outputs from the currently used energy systems. The emission of greenhouse gases affects the global ecosystem. At the same time, two billion people worldwide are lacking access to electricity and almost as many rely on traditional fuels to meet their everyday cooking and heating needs. This has a significant health impact, causing about 2 million premature deaths annually. Moreover, millions of people – mostly women and children – spend many hours every day hauling water and gathering fuels, which prevents normal school education and the pursuit of income-generating opportunities.

Access to modern energy services is essential to increase productivity, improve people's livelihoods, and inhibit the growth of a global ecological crisis. In

order to achieve the development of a green economy a multi-sectoral, strategic approach is needed to promote a new energy strategy as an engine for equitable growth. The supply of energy must be reoriented towards the promotion of an energy system based on renewables, energy efficiency and cleaner fossil fuel technologies.

The aim of the paper is to analyze the possibilities for realization of the aims of a green economy in the context of the EU climate and energy policy.

2. Global trends

The world is facing a rapidly growing population, the greenhouse effect and enlargement of the development disparities between regions. This period was called Energy-Climate Era by Thomas L. Friedman.¹ These problems include intensification of the greenhouse effect, biodiversity loss, rapid growth in demand for energy and natural resources, and enrichment of those countries which have oil deposits.² In order to solve these problems it is necessary to develop a new infrastructure, new ways of thinking, new tools, and new forms of cooperation. Therefore, it seems that RES constitute a new way of creating the green economy.

When we take present events into account (the conflict in the East), it is agreeing with the strict promotion of RES. How should the EU ensure its absolute energy security? Perhaps the EU should resist energy security based on the available energy source – coal? And then, after ensuring the stability and independence of supply from the East, continue to resolve the ambitious challenges to greening the energy sector. Undoubtedly the situation whereby the East demonstrates its power requires above all taking steps to ensure the energy security, and thus the socio-economic stability of the EU.

It should be noted that the global emission of greenhouse gases into the atmosphere reached 400 particles per million of carbon dioxide in mid-2013. This is the highest level of concentration, which has ever occurred in the world.³ It is therefore necessary to take intensive actions aiming at limiting further increases of the Earth's temperature. It is not realistic to achieve this goal by 2020.

The largest emitters of carbon dioxide are China and the OECD countries. Carbon dioxide emission was at 31734 Mt in 2012. The energy sector is respon-

¹ Thomas L. Friedman, (2008), *Hot, Flat, and Crowded*, Farrar, Straus and Giroux, New York.

² F. Krawiec (red.), (2010), *Rola odnawialnych źródeł energii w rozwiązywaniu globalnego kryzysu energetycznego* [The role of renewable energy sources in solving the global energy crisis], Difin, Warszawa, p. 5–6.

³ IEA, (2013), *Redrawing the Energy-climate map. World Energy Outlook Special Report*, France, p. 23.

sible for about two-thirds of greenhouse gas emissions. Fossil fuels represent 80% of global energy consumption.

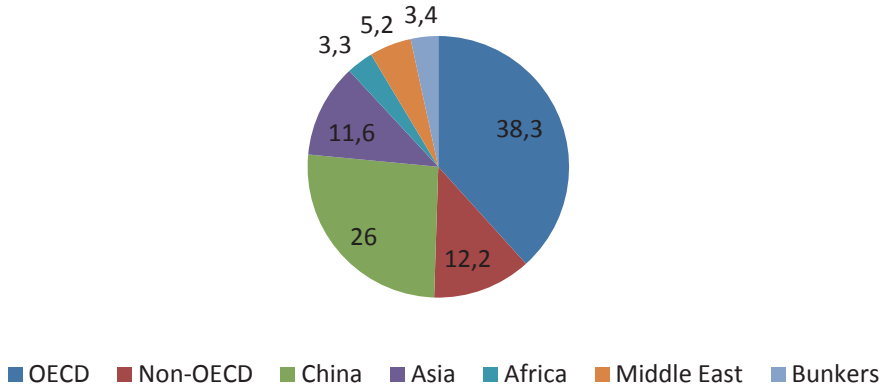


Figure 1. Share of CO₂ emissions by regions in 2012 [%]

Source: IEA, (2014), *Key World Energy statistics*, France, p. 45

The largest increase of carbon dioxide emissions within the space of fourteen years was reached in China (increase of 20.2 percentage points) and Asia (increase of 8.5 percentage points). In the OECD countries, the share of carbon dioxide emissions fell by 32.2 percentage points, and in non-OECD countries this decline was 6.6 percentage points.

There was also a rise in energy consumption in the world during this time. Final energy consumption level reached 8979 Mtoe in 2012, which means a twofold increase compared to 1973. Figure 2 shows the shares of total final consumption of fuels.

Oil has remained one of the most important energy sources in the world in forty years. Its share in total final consumption was 56.3% in 1973, and decreased slightly to 47.6% in 2012. There was a noticeable decrease in the share of coal consumption during this time – from 10.8% to 3.4%, and when calculated per unit of energy was used was 236 Mtoe of coal in 1973, and only 122 Mtoe in 2012. The most energy-intensive economies were the OECD countries (39.8% of total world energy consumption), followed by China – 19.1%, Asia – 12.7%, non-OECD countries – 13.5%, Africa – 6.0% and the Middle East – 5.0%.

Compared to 1973, energy consumption decreased by 3.6 percentage points in the OECD countries and 5.2 percentage points in the non-OECD countries. The highest growth was observed in China, where energy consumption increased

by 11.2 percentage points. Increases were also noted in the Middle East (by 4.3 percentage points) and in Africa (by 2.3 percentage points).

According to the UNEP report “Towards a Green Economy”, investment in sustainable energy to limit the emission of greenhouse gases could create employment, especially in the agriculture, construction, forestry and transport sectors. It is assumed that employment in agriculture would increase by 4%, in forestry by 20%, and in transport by 10%. It is also assumed that there would be a reduction of employment in the coal and oil production sectors, and that this decrease ought to be recompensated by the growth of employment connected with investments in improved energy efficiency.⁴ However, it is necessary to implement effective policies to support RES, otherwise these forecasts may not be realized.

3. EU policy in the context of supporting actions for a green economy

An important document concerning renewable energy sources development is the 2007 “Road Map for renewable energy”. Renewable energy sources are a tool to implement increase energetic security and reduce greenhouse gas emissions. It is necessary to outline long-term stable actions. The European Commission has set the target of a 20% share of renewable resources in gross domestic energy consumption by 2020. This was raised from the suggested 12% share of RES, which according to the European Commission would be ineffective to develop the RES market. Detailed objectives were established for biofuels – 10%, the production of electricity from renewable sources – 34% of total consumption, heat and cooling – 18%.⁵

This document stresses the need to eliminate all barriers to the development of RES. The main tasks are: simplifying the connection and expansion of the network; elimination of unnecessary bureaucracy in the context of renewable energy systems creation, especially for SMEs; increased access to market information; building support systems; internalization of external costs of energy from conventional fuels; implementation of a Biomass Action Plan; and support for the development of energy distribution.⁶ Fulfillment of these objectives will ensure the reduction of greenhouse gas emissions to 900 Mt by 2020, then to 600 Mt. According to the European Commission, the price of RES energy per unit will

⁴ UNEP, (2011), *Towards a Green Economy: Pathways to Sustainable Development and Poverty Eradication – A Synthesis for Policy Makers*, p. 13–16.

⁵ European Commission, *Roadmap for renewable energy. Renewable Energies in the twenty-first century: building a more sustainable future*, [SEK(2006)1719][SEK(2006)1720][SEK(2007)12], Brussel, 10.1.2007, COM(2006)848, p. 3–13.

⁶ *Ibidem*, p. 14–6.

go down in the long-term. The impact of rising energy prices will be eliminated by saving costs of greenhouse gas emissions.⁷

In 2008, the European Commission presented an energy climate package known as “3 x 20%”. This agreement was to integrate the energy sector with environmental policies to prevent climate change. The climate package determined targets for the share of renewable energy sources in gross final energy consumption. It is noted that the average increase in the share of renewables in the Member States is 8–12% compared to 2005. The share of biofuels in the transport sector has been set at the same level for all the countries – 10% share of biofuels in petrol and diesel.⁸ It should be pointed out that the goal was reached by countries such as Bulgaria, Estonia and Sweden.

In April 2013 the European Parliament in the project “Resolution on micro generation – small-scale electricity and heat generation” stated a.o. the need to support action enabling the development of local renewable energy cooperatives/associations and engaging communities. The guidelines aim to support the internal energy market, to enable the member states to implement the energy package and climate protection package by 2030 and to ensure energetic security in the long run.

Table 1. The potential energy savings in final energy consumption for sectors with barriers and proposed solutions

Sector	Share of final energy consumption (2006)	Potential energy saving in 2020	Proposed solutions	Barriers
1	2	3	4	5
Households	41%	30%	<ul style="list-style-type: none"> • Legal requirements with regard to regions and local communities • Technology development • Financial and fiscal support / incentives • Information dissemination (campaigns, labeling, certification) • Changing of patterns / trends 	<ul style="list-style-type: none"> • the high cost of implementation new technologies • lack of benefits awareness • excessive consumerism • lack of attractive financing

⁷ *Ibidem*, p. 16–20.

⁸ Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC.

Tab. 1 (cont.)

1	2	3	4	5
Transport	31%	20%	<ul style="list-style-type: none"> • Legal requirements with regard regions and local communities • High energy prices • labeling • increase consumer awareness • Information campaigns 	<ul style="list-style-type: none"> • lack of commitment to the transport industry • Lack of infrastructure • bad / generalized patterns of behavior
Industry	28%	19%	<ul style="list-style-type: none"> • high prices of energy and conventional fuel / coal • increased efficiency in the production • voluntary and mandatory contract 	<ul style="list-style-type: none"> • the high cost of implementation new technologies • limited involvement • low benefits awareness • lack of funding • Low participation • revaluation of investment needs

Source: Commission of the European Communities Brussels, 13.11.2008 COM(2008) 772 final communication from the Commission, Energy efficiency: delivering the 20% target, p. 17.

Energy efficiency is called the fifth fuel or the fuel of the future. The European Commission issued communication “Energy efficiency: realization the goal 20%.” It was found out that the progress in increase energy efficiency in EU is too slow and achieving reduction of energy consumption by 20% is not possible. According to the analyses, the potential energy saving for the industry is 19%, for transport 20% and for households and services 30%. It also identifies barriers for increase of energy efficiency in each sector, as well as shows key solutions.⁹

4. Poland in the light of energy greening

In the “Polish Energy Policy until 2030” main line of activities was indicated which include: improved energy efficiency, increased fuel and energy security, diversification of electricity generation structure by introducing nuclear energy, fuels and energy markets development, reducing negative impact of energy sector

⁹ European Commission, *Energy efficiency: delivering the 20 percent*, Brussels, 13.11.2008, COM(2008)772, p. 2–4.

and RES development including biofuels.¹⁰ These activities allow the integration mechanism enabling sustainable socio-economic development.

The renewable energy sources allow to increase energetic security because they are decentralized in nature. In addition, RES support most of energy policy goals e.g. increasing diversification of supplies to possible reduction of demand for energy from import, implementation of the energy-climate package by reducing greenhouse gases emissions and dusts, development of competitive markets and also growth in innovation and entrepreneurial human capital. In addition, the more distributed energy will be diffused and regional raw materials used for production of energy, the higher probability of ensuring local energy security and reduced energy transmission losses. The main objectives of energy policy in the area of RES are:

- increase the share of renewables to 15% in total energy consumption by 2020;
- use forests in minimum for biomass production and agricultural land in maximum to generate renewable energy sources;
- increase to 10% use of biofuels in all transport fuels by 2020;
- provide an appropriate framework for the sustainable development of distributed energy sources.

These activities are intended to effectively reduce carbon dioxide emissions, biodiversity protection and increase energy security by “Energy mix”, i.e. energy sources diversification.¹¹ About 13% of the energy produced in the world comes from renewable resources.¹² In Poland, the share of renewable energy in the total energy production in the years 2007–2010 increased from 6.69% to 10.16%.

Production of primary energy in the EU-28 totaled 794.3 million tons of oil equivalent – toe in 2012. Renewable energy accounted for 21.6% of primary energy produced.

Table 2. Primary production of renewable energy in 1 000 tons of oil equivalent

Source of energy	2008	2009	2010	2011	2012
1	2	3	4	5	6
Hydro power	28283,8	28544,1	32041,1	26549,4	28649,7
Wind power	10276,6	11444,3	12835,9	15471,3	17692,8
Solar thermal	1114,9	1358,4	1829,3	2215,4	3320,2
Solar photovoltaic	639,2	1205,6	1935,1	3896,6	5781,3

¹⁰ Ministerstwo Gospodarki, *Polityka energetyczna Polski do 2030 roku [Polish Energy Policy until 2030]*, adopted by the Council of Ministers on 10 November 2009 r., p. 3–4.

¹¹ *Ibidem*, p. 18–20.

¹² IEA Statistics, *Renewables information*, OECD/IEA 2012.

Tab. 2 (cont.)

1	2	3	4	5	6
Tide, Wave and Ocean	40	38,6	41,1	41,1	39,7
Solid biofuels (excluding char-coal)	68984,8	72195,8	80440,9	78835,7	8372,5
Biogas	6630,4	7413,4	8530,7	10380,1	12092,7
Municipal waste (renewable)	7288,6	7475,2	7958,8	8396,6	8738,3
Biogasoline	1383,7	1706,3	1979,7	1742,9	2036,2
Biodiesels	6612,7	7940,4	8914,2	8465,1	9187,9
Other liquid biofuels	881,6	998,7	822,9	333,3	306,8
Bio jet kerosene	0	0	0	0	0
Geothermal Energy	5547,7	5413,9	5438,9	5679,1	5698,7

Source: own study based on Eurostat.

The largest share in the production of renewable energy has biomass followed by hydropower, wind power, biogas, biodiesel and energy from organic waste. This trend is similar in Poland.

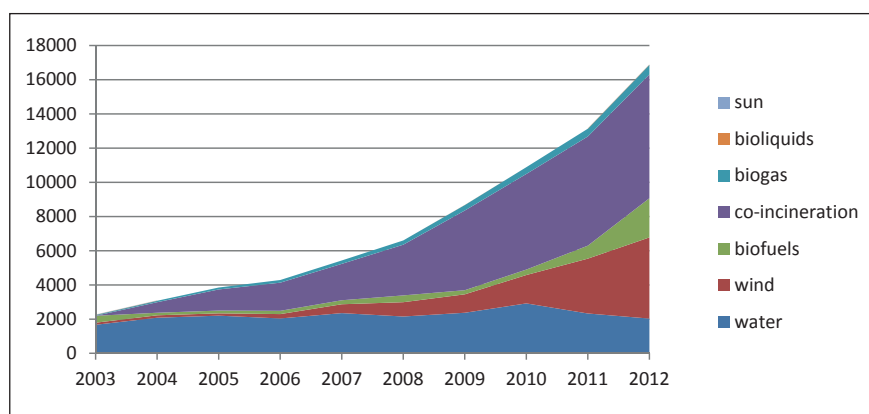


Figure 2. Production of electric power from renewable resources in the years 2003–2012 [GWh]

Source: Urząd Regulacji Energetyki [Energy Regulatory Office]; data from the Towarowa Giełda Energii [Polish Power Exchange] for 2010; GUS, *Energia ze źródeł odnawialnych w 2012 r.* [Renewable energy in 2012], Warszawa 2013, p. 57

Electricity production from renewable resources in Poland in 2012 was 16,879 GWh. The structure of electricity production from renewable energy resources is presented in Figure 3. Co-incineration of biomass and coal has the lar-

gest share. This method is, however, controversial. The factors justifying the use of this method are: the lack of continuous supply of good quality biomass, lack of properly functioning local biomass markets and the lack of implementation of appropriate technology in large power plants and co-generating power plants.

Heat production from renewable resources in Poland in 2012 was 19,548 TJ. The structure of heat production from renewable energy resources is presented in Figure 4.

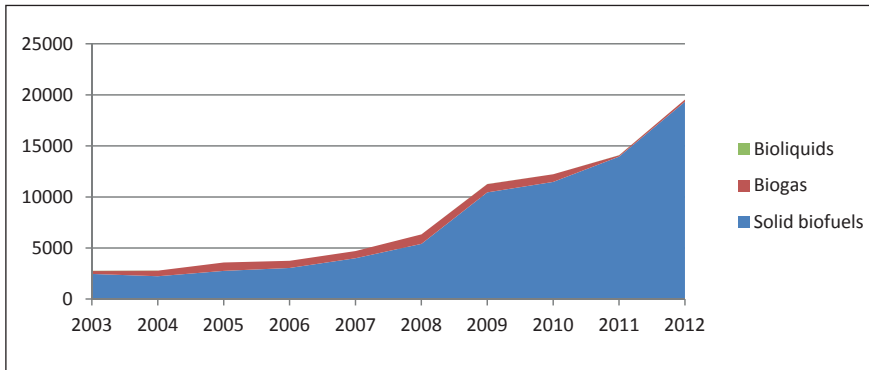


Figure 3. Production of heat from renewable resources in the years 2003–2012 [TJ]

Source: own study based on CSO (GUS), (2013), *Energia ze źródeł odnawialnych w 2012 r.* [Renewable energy in 2012], Warszawa, p. 63

According to Annex 1 of Directive 2009/28 / EC, Poland should reach in years:

- 2011–2012 average 8,76%¹³ share of RES in gross final energy consumption,
- 2013–2014 average 9,54%,¹⁴
- 2015–2016 average 10,71%,¹⁵
- 2017–2018 average 12,27%.¹⁶

There is an observable trend of increase in primary energy consumption in Poland. In 2012, the total stood at 4,443 PJ. The average energy consumption per capita was 114.4 GJ.

¹³ $S_{2005} + 0,20 (S_{2020} - S_{2005})$, as average two years 2011–2012, where: S_{2005} = share of each country in 2005, and S_{2020} = share of each country in 2020.

¹⁴ $S_{2005} + 0,30 (S_{2020} - S_{2005})$, as average two years 2013–2014.

¹⁵ $S_{2005} + 0,45 (S_{2020} - S_{2005})$, as average two years 2015–2016.

¹⁶ $S_{2005} + 0,65 (S_{2020} - S_{2005})$, as average two years 2017–2018.

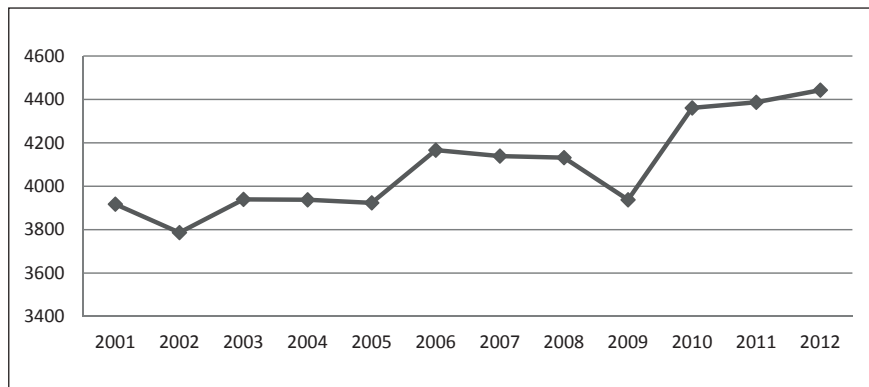


Figure 4. Consumption of primary energy in Poland in 2001–2012

Source: own study based on CSO (GUS), (2012), *Gospodarka paliwowo-energetyczna w latach 2010, 2011* [Energy and fuel economics in 2010, 2011], Warszawa, p. 52; GUS, (2013), *Gospodarka paliwowo-energetyczna w latach 2011, 2012* [Energy and fuel economics in 2011, 2012], Warszawa, p. 52

According to an optimistic forecast, Poland will be able to cover 26% of electricity demand from renewable energy sources by 2020, and by 2050 up to 80%. Half of the renewable energy will be wind power, 19% biomass and 12% solar energy. The forecast shows independence of the country from coal in 2050, when the electricity generated from coal will be 6% and brown coal will be withdrawn from the production of energy. In contrast, the pessimistic forecast is connected with the continued use of coal in electricity production in 2050, which will satisfy more than half of the demand. A slightly different forecast is shown for heat power demand from renewable energy sources. It is estimated that biomass will cover 36% of the demand, solar – 10% and geothermal – 3%, which all constitute almost half of the demand. Moreover, the demand for heat energy in the long-term will decrease as a result of improving thermal insulation of buildings and by 2050 the need for such type of energy will decrease by 30%.¹⁷

According to the forecasts of the Ministry of Economy the economic potential of energy crops will reach 250.3 PJ in 2020. While the demand for biomass will be 299 PJ in 2020. According to forecasts energy prices could rise twofold.¹⁸

¹⁷ G. Wiśniewski, (2008), [R]ewolucja energetyczna dla Polski. Scenariusz zaopatrzenia Polski w czyste nośniki energii w perspektywie długookresowej [Energy [r]evolution for Poland: A scenario of a long-term supply of clean energy], Wydawca Greenpeace Polska, październik, p. 7–8.

¹⁸ Ministerstwo Gospodarki, (2009), *Prognoza zapotrzebowania na paliwa i energię do 2030 roku* [Forecast demand for fuels and energy until 2030], Warszawa.

In 2012 467.4 PJ of heat and 525.1 PJ of electricity was used.¹⁹ The share of renewables in primary energy production was only 11.7% in 2012. Poland is obliged to achieve 15% of energy from renewable sources in final energy consumption in 2020. The difference between the primary and final energy is that the primary energy is included in the original carriers obtained directly from the environment. Whereas, the final energy is converted primary energy with consideration to the efficiency of its processing. Therefore, it seems that the implementation of the Polish commitments is going to be difficult to achieve. One of the instruments to support the development of renewable energy are certificates of origin, the so-called green certificates. The problem is that the market is unstable. This is confirmed by a large price drop of green certificates in December 2012.

5. Conclusion

The implementation of the objectives of the green economy is nowadays a challenge for many countries, including Poland. According to the pessimistic version we are not going to be able to fulfill the indicative target for the share of renewable energy sources. There are many reasons to this situation. The first of them all is the lack of appropriately matched legislation, despite adopting the RES resolution after a long time. Institutional arrangements in this area do not exist. The Polish economy is dependent on coal and gas supplies from Russia. An appropriate share of energy production from RES was possible in large part by co-firing solid biomass with coal. This is confirmed by a large price drop of green certificates in December 2012 (from 226,51 PLN in November 2012 down to 130.31 PLN in February 2013). Green certificates market crisis has had a negative impact on biomass producers. After the experience of the end of 2012, a further development of the agricultural biomass seems to be difficult. Many producers of biomass were affected by this crisis. The fact is that this support instrument significantly affects energy production from renewable sources, and it has negative influence for development of RES market in Poland. Moreover, in Poland compared with other EU countries was offered very high support for co-incineration. That was the main reason for the preparation of investment plans, which stimulated co-incineration by the large energy companies. This policy led to a massive import of biomass from abroad, because in Poland there is no more support to develop energy crops plantations. Moreover, these activities are incompatible with the objectives of the green economy. Sustainable use of resources and reduction of the negative impact on the environment seem doubtful. The EU climate and

¹⁹ GUS, (2012), *Gospodarka paliwowo-energetyczna w latach 2010, 2011* [Energy and fuel economics in 2010, 2011], Warszawa.

energy policy aims at reducing emissions, as well as the greening of the energy sector. The use of renewable energy sources, especially biomass, helped reach that goal. In contrast, taking in to consideration the environmental cost of biomass imports from Belarus, Ukraine, Brazil or China we cannot talk about reducing emissions. Implementation of a green economy in Poland requires a definite change in the approach to energy policy.

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ABSTRACT

The aim of this chapter is to analyze possibilities of implementation of a green economy in EU countries in the context of climate and energy policy. The main aims of green economy are: to reduce greenhouse gases, to improve the efficiency of the use of resources, to protect ecosystems and biodiversity, to develop green sectors. Achieving these targets can be supported by the use of renewable energy sources.

Key words: green economy, renewable energy sources.

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