

ECOLOGICAL ASPECTS OF ENERGY SECURITY IN BELARUS

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Abstract

The new version of the Concept of Energy Security of the Republic of Belarus was adopted by Government in December 2015. This document defines the main indicators of clean energy development in the country until 2035: nuclear energy and renewable energy sources. Currently, both these areas are under implementation.

Keywords: energy security, environment, nuclear power, renewable energy sources

1. INTRODUCTION

Energy security remains one of the most important socio-economic problems of the Republic of Belarus. At the same time, the Republic signed and ratified the Paris Climate Agreement. Despite a number of positive changes, the energy intensity of the Belarusian economy remains quite high compared with neighboring countries (Fig.1).

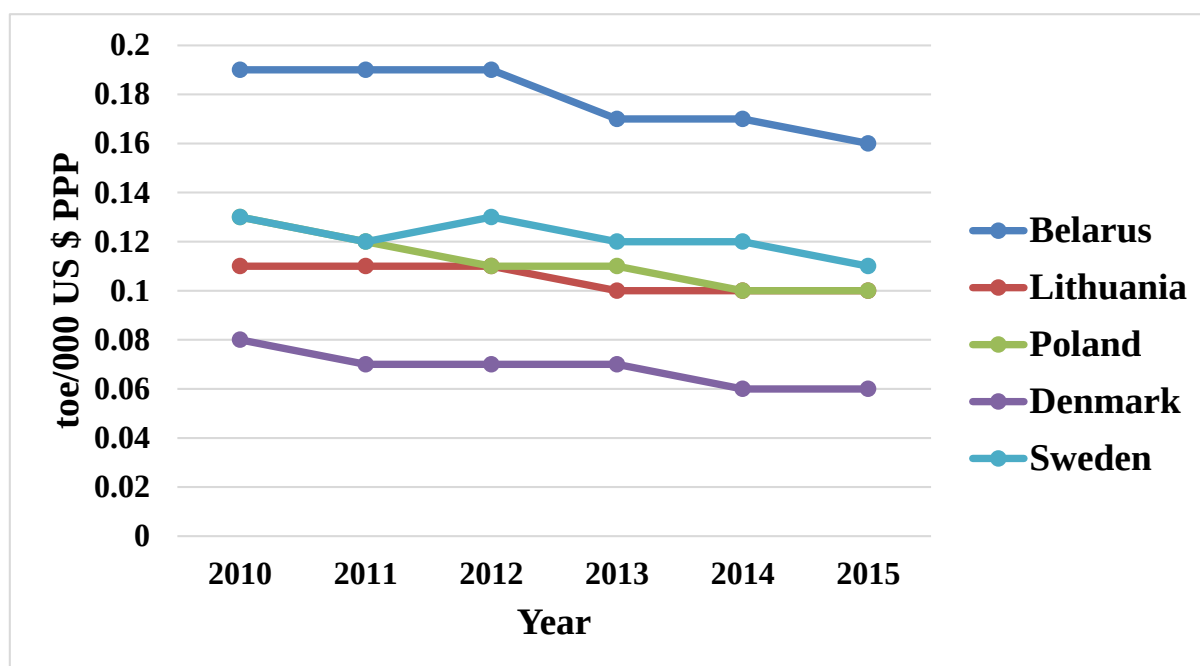


Fig. 1. Primary energy- GDP intensity of Belarus and other countries

As shown in Fig. 1, the energy intensity of economy in the Republic of Belarus significantly exceeds this figure in neighboring countries of Western Europe. This results in respective emission of pollutants into the environment.

2. STRUCTURE AND DYNAMICS OF EMISSION

However, in terms of the amount of emission to the environment from fuel combustion, Belarus in recent years has approached the average level of the European Union countries (Fig. 2). CO₂ emissions per capita in Belarus are higher by 1.5 times than in Latvia and Romania, but lower by 2 times, than in Estonia.

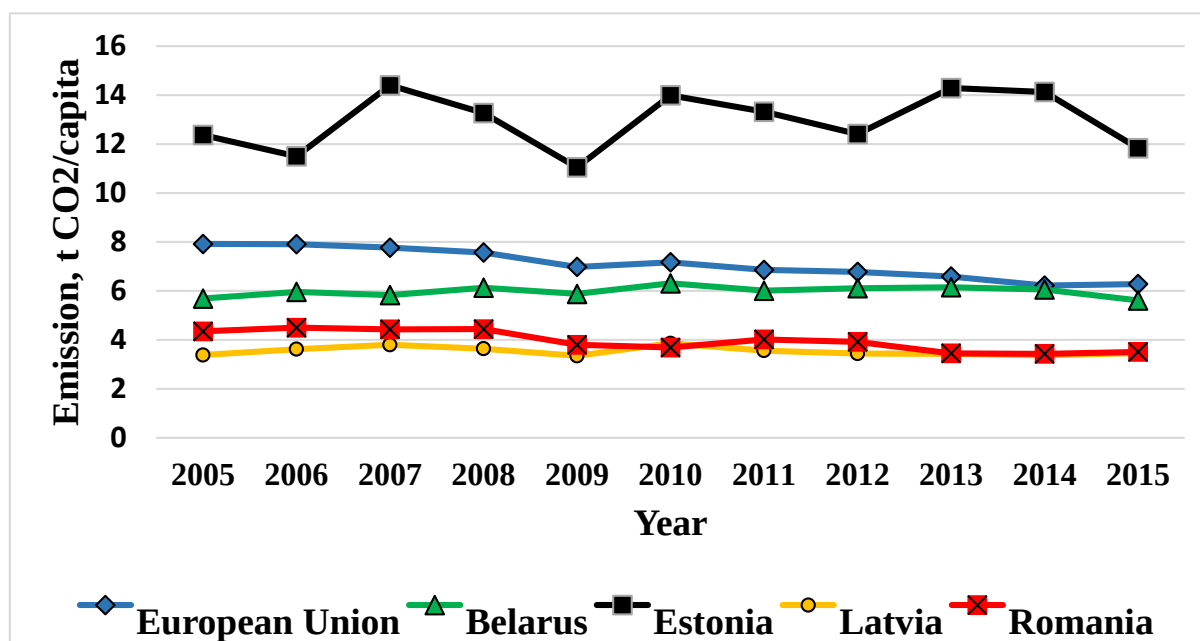


Fig. 2. CO₂ emission from fuel combustion in different countries

In addition to CO₂, significant amounts of CO, NO₂, SO₂ and solid particles from stationary sources were emitted (Fig.3).

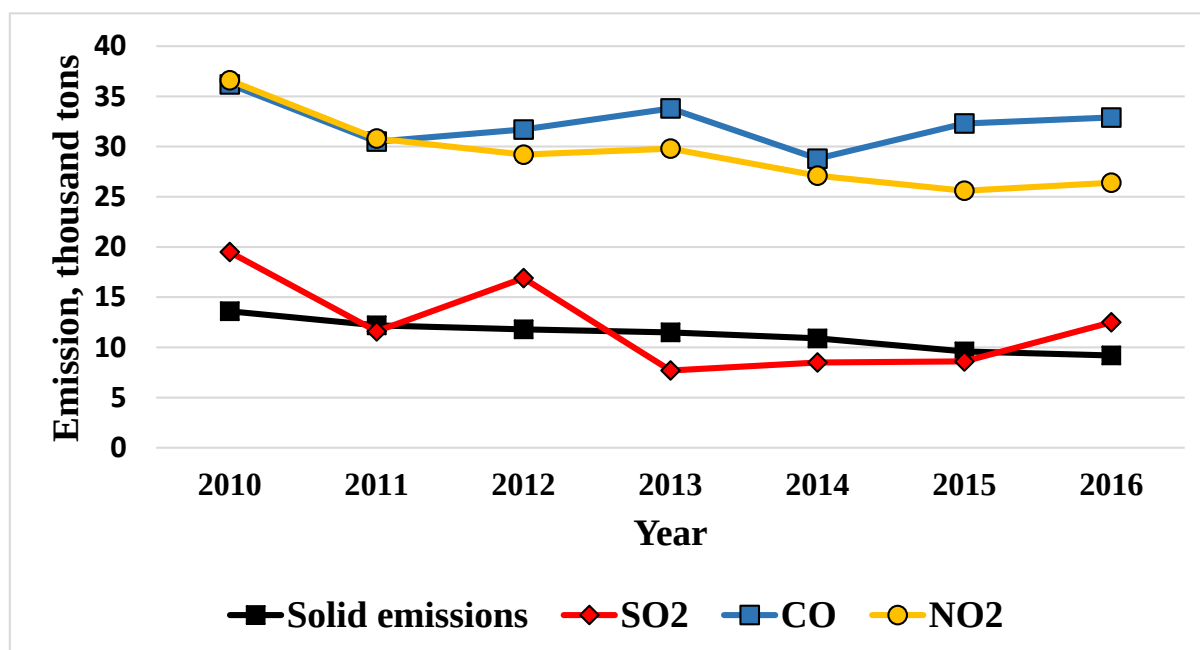


Fig. 3. Emission into atmospheric air from stationary sources from fuel combustion

As can be seen from the data presented in Fig. 4, mobile sources (road transport) are the main source of pollutant emission into the atmosphere (about 65%). Despite the constant increase in cars in the country, emission from them are reduced due to the renewal of the car park.

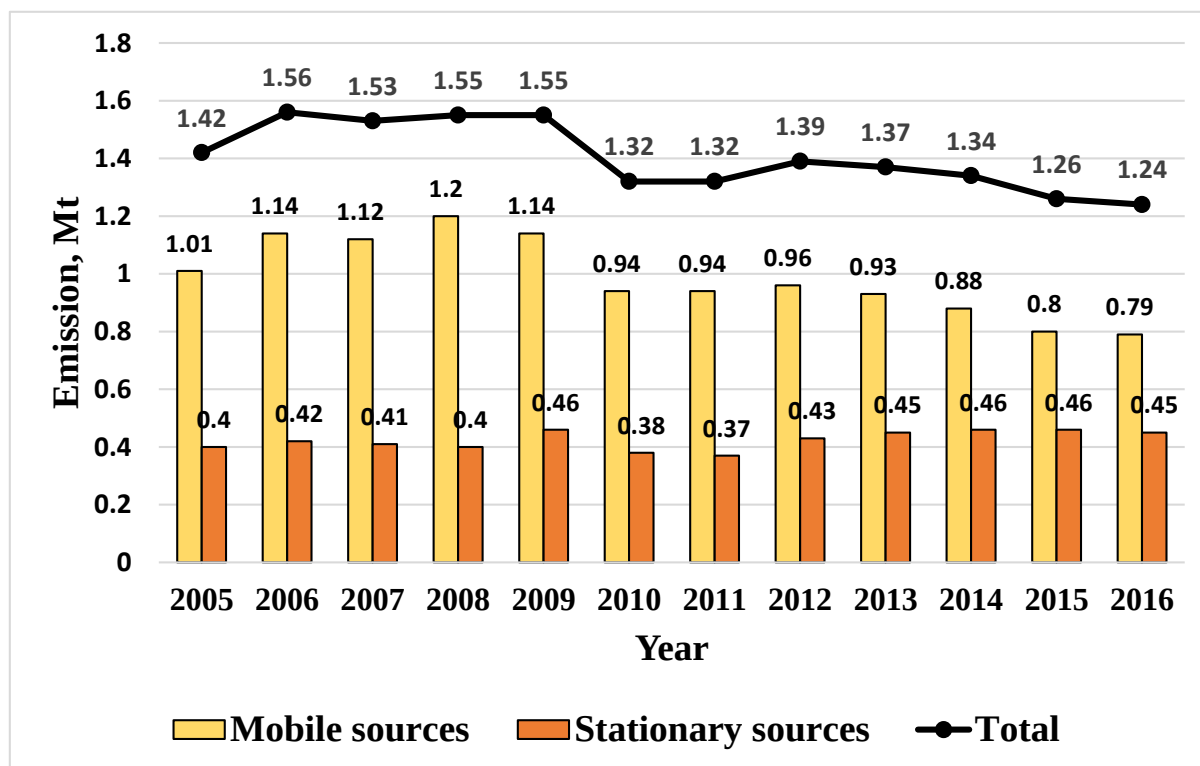


Fig. 4. Emission into atmospheric air by source types in Belarus

In September 2015, the President of the Republic of Belarus signed a decree according to which, in accordance with the Paris Agreement, the Republic obliges to reduce by 28% greenhouse gas emissions by 2030 compared to 1990. Two directions of this activity are set out in the Energy Security Concept of the Republic of Belarus, namely: nuclear power and renewable energy sources.

3. ENERGY SECURITY CONCEPT OF THE REPUBLIC BELARUS

The Concept of Energy Security (here and below referred as the Concept) was approved by Decree of the Council of Ministers of the Republic of Belarus in December 2015 and was considered like the main document determining current and perspective state of energy security in the country as well as the main approaches for providing its reliable energy supply up to 2035 [1]. According to this Decree the National Academy of Sciences of Belarus was appointed the main national institution for implementation of monitoring of energy security. The Academy is responsible for annual reporting of state of energy security to the Council of Ministers.

The method of indicative analysis was applied for quantitative assessment of energy security in Belarus [2]. According to this method assessment of state of the country's energy security is made on the basis of three possible values of indicators: normal, subcritical and critical. According to the Concept energy security system of Belarus includes 11 indicators as well as its threshold and perspective values till 2035. It allows to implement an objective monitoring and control of energy security state. Among the 11 indicators, 4 are related to one degree or another with environmental aspects. They are presented in Table 1.

Table 1. Selected Energy Security Indicators of Belarus

Indicator	Threshold Level		Value	
	Normal	Critical	2016	2035
Domestic primary energy production to total primary energy consumption ratio, %	30	16	14,9	20
Renewable energy production to total primary energy consumption ratio, %	14	5	6	9
Share of a dominant fuel in total energy consumption for electricity and heat production, %	50	80	96,7	< 50
Energy intensity of Gross Domestic Product, kg ce/ MBYN (2005 prices)	160	485	378	268

Currently Belarus faces several considerable threats to sustainable and reliable energy supply. The main of them are: low geographical and structural diversification of energy import; possible restrictions of energy import from the dominant supplier because of economic and political reasons; development of energy transit routs by neighboring countries alternative to Belarus; high share of one energy source (natural gas) consumption for heat and electricity production; low per capita specific electricity consumption in Belarus in comparison to developed countries with similar climate conditions; expected increased imbalance of electric capacities in night hours after commissioning of Belarusian nuclear power plant. Most of threats mentioned have a long-term character. As a result, Belarus needs a systematic approach to achieve main goals indicated in the Concept.

Thus, according to the Concept, the share of renewable energy sources in the overall energy balance should increase by 50%, the share of natural gas as fuel will almost halve, the energy intensity of GDP will decrease by a factor of 1.4 by 2035 (Table 1).

Achieving these goals will be mainly achieved through the development of nuclear power and renewable energy sources.

4. CURRENT NUCLEAR STATUS OF BELARUS

At present two units of Belarus NPP are under construction (Fig.5). The electrical capacity of each unit is 1194 MW. The first unit is planned to be commissioned in 2019, the second - in 2020. The designed capacity factor is estimated to be 0,92, life-time of the power unit operation is 60 years; electrical efficiency is 36.56% (gross) Operation of two nuclear power units will reduce the burning of natural gas by 4.5 billion cubic meters per year.



Fig. 5. Panorama of the construction of the Belarusian NPP

5. RENEWABLE ENERGY SOURCES

In 2016-2017, construction of renewable energy sources was continued in Belarus. The largest solar power plant was built by WELCOM in August 2016 near the town of Bragin in the territory of about 50 hectares. The total capacity of the SES was 18.5 MW, the construction cost - 24 million euros.



Fig. 6. Solar power plant near the city of Bragin

It is reported that the VELCOM solar park has become the largest in the country, both in size and capacity. Park consists of 85 thousand solar panels that convert solar radiation into direct current electricity. After that, it enters 617 inverters with a voltage of 0.4 kV, which converts it into alternating current. With the help of 10 transformer substations, the voltage is increased to 20 kV. In turn, a powerful transformer brings it up to 110 kV - a level that is necessary to transfer electricity to a network.

To connect all the panels and equipment, more than 730 km of cables are laid in the sun park, which in addition exceeds the distance from Minsk to Moscow.



Fig. 7. Wind power plant near the city of Novogrudok

As it was mentioned above, mobile transport strongly pollutes the environment (Table 2). Therefore, Belarus starts to develop electric transport. In addition to continuing the electrification of the railways, the first electric buses began to be operated in the city of Minsk (Fig. 8), and the first electric domestic car (Fig. 9) was created in the National Academy of Sciences (Joint Machine Building Institute).

Table 2. Emission into atmospheric air from mobile sources

Type of emissions	Year						
	2010	2011	2012	2013	2014	2015	2016
CO	619,1	612,8	618,2	604,4	576,5	526,9	521,3
NO ₂	99,9	104,9	105,7	101,7	95,1	85,1	84,0
SO ₂	2,6	2,7	2,7	0,3	0,2	0,1	0,0
Hydrocarbon emission	190,8	193,4	198,5	192,7	182,0	164,5	163,1
Soot emission	29,8	30,5	30,8	29,3	27,0	23,9	23,3



Fig. 8. Electric bus in Minsk



Fig. 9. The first domestic electric car in Belarus

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