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ENERGY EFFICIENCY AS PRECONDITION OF ENERGY SECURITY

Juozas Baublys[1], Vaclovas Miškinis[2], Inga Konstantinavičiūtė[3], Vidas Lekavičius[4]

[1]The General Jonas Žemaitis Military Academy of Lithuania, Šilo Str. 5 A, LT-10322 Vilnius, Lithuania
[2,3,4]Lithuanian Energy Institute, Breslaujos Str. 3, LT-44403 Kaunas, Lithuania

E-mails:[1]juozas.baublys@mil.lt; [2]miskinis@mail.lei.lt; [3]inga@mail.lei.lt; [4]vidas@mail.lei.lt

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Abstract. Increase of energy efficiency remains as one of the major strategic objectives in Lithuania. Effective use of existing energy saving potential increases energy security and reduces emissions of greenhouse gas and other pollutants. In order to meet the growing energy demand and to reduce the negative impact of the energy sector on environment, increase of the role of renewable energy sources in the country's primary energy balance, as well as larger deployment of energy-efficient and smart technologies in all areas, including military structures, are required. When analysing energy security and energy efficiency, as the two interrelated aspects of the Lithuanian energy policy, assessment of the global energy trends in the world, the EU and neighbouring countries, expected developments in the modern technologies, as well as global aspirations to neutralize the threat of climate change was performed. The paper provides an overview of energy consumption trends in the European Union and Lithuania, energy policy in the NATO alliance, as well the current status of energy consumption in the Lithuanian National Defence System.

Keywords: energy security, energy efficiency, energy intensity, energy policy, energy strategy

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1. Introduction

The Lithuanian energy sector was surviving dramatic changes over the last few years. Due to the closure of Ignalina Nuclear Power Plant with electricity generation cost, which was much lower than in any thermal power plant using fossil fuels, dependence on energy imports increased very significantly. On the one hand, use of local energy resources (peat, local oil, energy from chemical processes) and renewable energy sources over the period 2000-2012 increased by 35.1% and their share in the country's primary energy mix has increased from 15.9% in 2000 to 20.9% in 2012. Conditions for primary energy and electricity supply have been radically changed due to the closure of the main electricity generation sources. Ignalina Nuclear Power Plant could be replaced in principle by Lithuanian Power Plant and nuclear fuel as the main fuel for electricity generation – by natural gas.

Electricity generated by units at Lithuanian Power Plant, which were commissioned in 1960-ies and 1970-ies and are fired by expensive natural gas, is not competitive in the market. To enhance the efficiency of Lithuanian Power Plant and to reduce the price of electricity generation, a modern combined cycle gas turbine unit was commissioned in 2012. However, due to the very high price of natural gas, cost of electricity generated

at the majority of power plants in the country, including the ninth unit at Lithuanian Power Plant, is too high to compete with imported electricity price. Therefore, Lithuania since 2010, has become the electricity importing country –5.99 TWh were imported in 2010, 6.74 TWh in 2011 and 6.62 TWh in 2012.

The Lithuanian energy policy should be shaped taking into consideration the complicated geopolitical situation, which is important not only in the historical context of the Lithuanian nation, but has a number of factors influencing the future of international political relations. Being in the center of Europe, Lithuania still faces many difficult challenges, in particular in cases where, for various reasons, the political-militaristic equilibrium in neighbouring countries is becoming unstable and unpredictable. Integration of Lithuania into the EU created favourable preconditions for introduction of legal basis of the EU regulatory and public administration system and has opened up new opportunities. In addition, Lithuania, being a small country, can quickly adapt to the rapidly changing trends of economic globalization and take advantage from the development of information technologies. To use successfully these advantages close regional cooperation and harmonization of the country's foreign policy with Poland, Latvia, Estonia and Scandinavian countries is required. Currently, the biggest challenges in the energy sector remain the dependency on a single supplier of natural gas and still limited possibilities to import electricity from the Nordic electricity market.

The aim of this paper is to discuss trends of primary energy consumption in the EU-28 countries, to focus on comparative analysis of energy efficiency in the Baltic States and the EU-28 countries, to discuss the possibility to comply with the country's international obligations, as well as the current status of energy use in the Lithuanian National Defence System.

2. Trends of energy consumption in Lithuania and EU-28

During the last few years conditions and options for electricity supply in Lithuania, as well as volume of primary energy consumption and structure of the country's energy balance have changed significantly owing to the closure of Ignalina NPP. Fluctuations in primary energy consumption over the period 2000-2008 were caused by variation in electricity export – the more electricity was exported the more nuclear fuel was consumed for its generation (Figure 1). However, the primary energy consumption in Lithuania over this period in principle was increasing on average by 3.5% per year. Owing to the closure of Ignalina NPP and the very high prices of natural gas, electricity generated by major power plants, including combined cycle gas turbine unit at Lithuanian Power Plant, is not competitive electricity market.

Due to the dramatic decline in the volume of electricity production and at the same time significant reduction of losses in the energy transformation sector, total primary energy consumption over the past three years has been on average by 17% less compare with the 2009 level, but dependence on energy imports from Russia increased significantly. While consumption of local and renewable energy sources increased over the period 2000-2012 by 35.1%, the share of all local energy sources in the country's primary energy mix in 2012 accounted for only 20.9%.

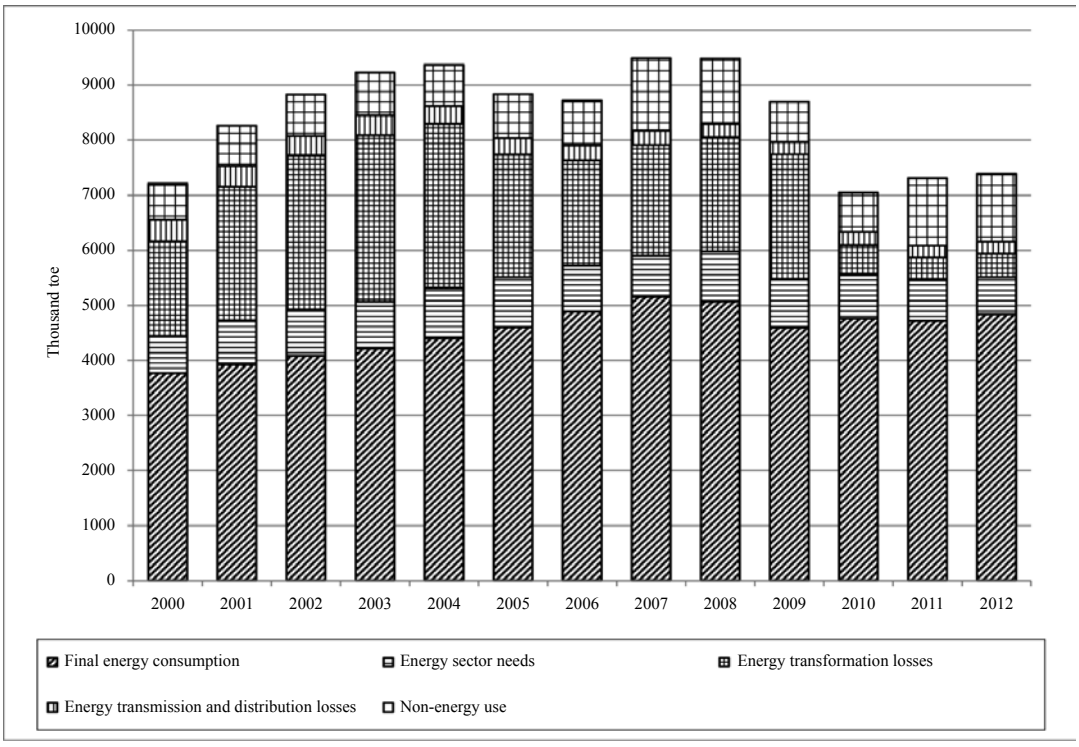

Fig.1. Primary energy consumption in Lithuania

Source: Statistics Lithuania (2013, 2014)

As one can see from the data presented in Table 1, currently natural gas and petroleum products dominate in the Lithuanian primary energy consumption. At present natural gas is technologically and ecologically the most effective imported fossil fuel. In 2012, total consumption of natural gas amounted to 2654.7 thousand toe, and the share of gas in the primary energy balance amounted to 35.9%. Natural gas dominates in the balance of fuel, which is consumed for electricity and district heat production. A large portion of the gas (about 40%) is used for non-energy purposes and about 20% of the gas is consumed directly by final consumers.

Lithuania possesses all the technical capabilities for importing oil and petroleum products from different countries. Thus it has achieved diversification in the supply of petroleum products and is technically secured against possible disruption of supply from any one country. In 2012, total consumption of petroleum products including biofuels amounted to 2590.1 thousand toe, and their share in the primary energy balance amounted to 35.1%. The majority (about 60%) of petroleum products is consumed in the transport sector, about a quarter is used by oil refinery and for non-energy needs, and about 6% are consumed by final consumers. During this period consumption of oil products for electricity and district heat production was continuously decreasing. In 2012, only 6.3% of all petroleum products were used for this purpose.

Table 1. Primary energy consumption in Lithuania, thousand toe

	2000	2005	2006	2007	2008	2009	2010	2011	2012
Electricity import	-114.9	-255.1	-36.8	-118.0	-82.3	-252.1	515.1	579.5	569.3
Coal	80.0	168.2	233.0	222.8	189.1	145.0	182.5	210.3	200.2
Peat	12.5	17.4	18.8	27.9	24.4	25.2	27.1	32.0	36.9
Wood, wood waste and biogas	645.8	836.7	875.0	864.6	912.4	945.3	949.9	926.2	1014.9
Natural gas	2064.3	2476.9	2454.5	2892.1	2596.0	2181.6	2492.0	2718.8	2654.7
Oil products	2166.8	2691.3	2710.9	2779.1	3017.4	2547.6	2599.4	2512.8	2590.1
Nuclear	2193.9	2694.0	2254.5	2562.4	2578.3	2828.2			
Energy from chemical processes	130.5	167.2	173.7	211.0	199.9	214.6	209.4	244.3	235.9
Hydroenergy	29.2	38.8	34.2	36.2	34.6	36.5	46.4	41.3	36.3
Geothermal energy		2.9	1.7	1.5	0.6	5.1	4.5	3.2	3.8
Wind and solar energy		0.2	1.2	9.1	11.3	13.6	19.3	40.9	46.7
Total consumption	7208.3	8838.2	8720.4	9488.4	9481.4	8690.4	7045.2	7309.0	7388.4
Total internal production	3340.7	4001.7	3584.7	3910.4	3982.3	4346.3	1522.7	1537.5	1558.5
Energy dependence	53.7	54.7	58.9	58.8	58.0	50.0	78.4	79.0	78.9

Source: Statistics Lithuania (2013, 2014)

Role of wood, wood waste and biogas is increasing – in 2012, their total consumption amounted to 1014.9 thousand toe, and the share of bioenergy in the primary energy balance accounted for 13.7%. Consumption of this fuel is growing rapidly in boilers and power plants – in 2012, consumption of bioenergy for district heat and electricity production increased by 7.9 times compare with the 2000 level. However, the main part of the wood fuel is still consumed by households that are not connected to the district heating systems.

Contribution of other renewable energy sources (hydropower, solar, wind energy and geothermal energy) for electricity and heat production is still comparatively low – in 2012, total consumption of these energy sources was 86.9 thousand toe, and their share in the primary energy balance was 1.2%. Consumption of other local energy sources (peat and energy from chemical processes) amounted to 272.4 thousand toe in 2012, and the share of these sources in the country‘s energy balance was 3.7%. Consumption of coal and other solid fuels is also low – in 2012, total volume was 200.2 thousand toe, and their share in the primary energy balance amounted to 2.7%. And vice versa, contribution of electricity imported from neighbouring countries is comparatively high – in 2012, it amounted to 569.3 thousand toe and the share in the country‘s energy balance was 7.7%.

Growth or decline of primary energy demand is influenced by many factors: the change in the energy transformation sector, the energy consumption in the energy sector and non-energy use and volumes of energy consumption by end-users. Economic activity in the Baltic States has been growing very rapidly over the period 2000-2008, and energy demand was increasing in all sectors of the economy. This factor has led to a trend of primary energy consumption growth in Estonia, Latvia and Lithuania. As shown in Figure 2, growth of the primary energy demand in the Baltic countries was similar and significantly higher than the average in the EU-28. In 2007, primary energy consumption in Lithuania was by 31.7 %, in Latvia by 26.5%, and in Estonia by 23.7% higher than in 2000. Meanwhile, rate of economic growth in the EU-28 countries was significantly lower and the primary energy consumption increased during this period by only 4%. In 2009, global economic crisis has resulted in reduction of primary energy consumption in Estonia by 10%, in Lithuania by 8.7%, in the EU-28 countries on average by 5.8%, and in Latvia by 4%. In 2010, due to recovery of economy energy consumption in most countries has been growing, and in Lithuania owing to closure of Ignalina NPP decreased by 20%.

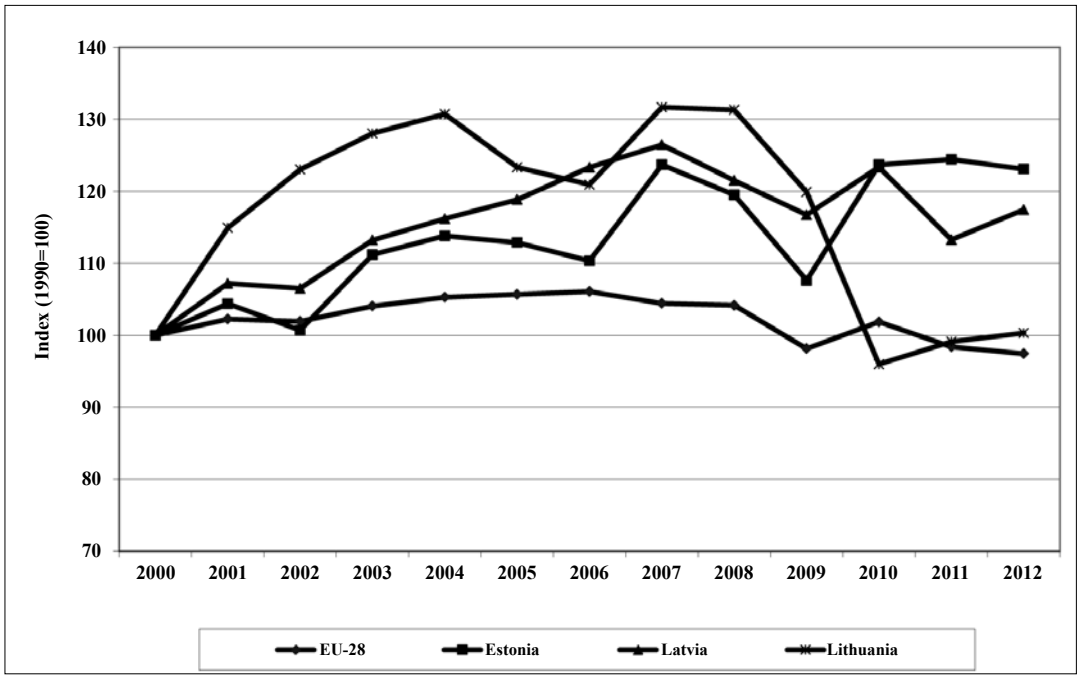

Fig.2. Index of primary energy consumption in the EU-28 and Baltic States

Source: Eurostat (2014), Latvijas statistika (2014), Statistics Estonia (2014), Statistics Lithuania (2014)

The European Union is facing challenges resulting from increased dependence on energy imports, comparatively limited energy resources, as well as ambitious objectives to stabilize climate change and to overcome the economic crisis (Lankauskienė, Tvaronavičienė 2012; Tvaronavičienė 2012; Balkienė 2013; Mačiulis, Tvaronavičienė 2013; Vosylius *et al.* 2013; Balitskiy *et al.* 2014; Peker *et al.* 2014, Scaringelli 2014; Tvaronavičienė 2014; Vasiliūnaitė 2014). Energy efficiency achieved through innovative technological solutions is assumed as a valuable means to address these challenges (Balkienė 2013; Laužikas, Mokšeckienė 2013; Ala-Juusela *et al.* 2014; Guruz, Scherer 2014; Cuneo *et al.* 2014; Barberis *et al.* 2014; Figurska 2014; Lankauskienė 2014; Raudeliūnienė *et al.* 2014; Tarabkova 2014; Tvaronavičienė *et al.* 2014). Directive 2012/27/EU of the European Parliament and of the Council of 25 October 2012 on Energy Efficiency was approved with an objective of saving 20% of the EU primary energy consumption by 2020 compared to projections in 2007 (Directive 2012/27/EU 2013). All Member States have now notified their national indicative targets. However, European Commission is concerned from preliminary assessment of national obligations – „the national indicative energy efficiency targets, taken collectively, suggest that the Member States aim to achieve only about 16.4% primary energy savings and 17.7% final energy savings by 2020“ (Communication 2013).

Lithuania and the other Baltic countries have a vision of rapid economic growth in the medium and long-term period, which allow reaching an average of economic development in the EU-28 countries in terms of GDP per capita measured in Purchasing Power Standards. The economic growth in this case will be followed by increase of final energy consumption, which provides appropriate conditions for the development of economic activities in all branches of the national economy (Balkienė 2013; Tvaronavičienė 2012; Vosylius *et al.* 2013; Balitskiy *et al.* 2014; Peker *et al.* 2014, Scaringelli 2014; Tvaronavičienė 2014; Vasiliūnaitė 2014). Enhancement of energy efficiency will guarantee slower pace of energy demand growth. However, commitment to reduce primary energy consumption in absolute terms may limit economic growth of the Baltic States. To solve this challenge, Lithuania can take advantage from Article 3 of the Directive, which provides that "each Member State shall set an indicative national energy efficiency target, based on either primary or final energy consumption, primary or final energy savings, or energy intensity" (Directive 2012/27/EU). Implementation of energy efficiency measures in all chain of energy transformation, distribution and final consumption may slow down or partially compensate growth of primary energy demand.

3. Changes in energy efficiency

Lithuania inherited from the Soviet past powerful energy sector, much larger than the domestic requirements, and energy-intensive economy which was oriented to Eastern market and inappropriate in terms of the country's size, access to raw materials and primary energy (Valentukevičius, Miškinis 2001; Tvaronavičienė 2014). Therefore, energy efficiency in the National Energy Strategy (National Energy Strategy 1999), approved by the Parliament in 1999, and in the National Energy Strategies updated in 2002, 2007 and 2012 has been and remains one of the most important strategic goals.

Energy efficiency in Lithuania increased significantly over the period 2000-2012. This increase is confirmed by reduction of energy intensity indicator (Dudzevičiūtė 2013; Vosylius *et al.* 2013; Lankauskienė 2014; Raudeliūnienė *et al.* 2014; Prause 2014). This indicator is used for comparative analysis of energy efficiency very often; in particular in a case there is no possibility to describe the energy consumption by technical and physical parameters. Energy intensity is usually defined as the ratio of gross primary energy consumption (measured in units of energy) and the GDP, gross value added or other indicator of economic activity (calculated in national currency or a common currency) (e.g. Vosylius *et al.* 2013).

Primary energy intensity was decreasing over the period 2000-2012 in all EU-28 countries. As one can see from Table 2, energy efficiency according to this indicator increased over this period in Lithuania by 70.2%, in Poland by 43.1%, in the Czech Republic by 35.6%, in Latvia, by 30.7%, in Estonia by 30.3%. In developed countries energy efficiency was increasing much more slowly – in 2012, primary energy intensity in Germany decreased compare with the 2000 level by 23.1%, in Finland by 16.7%, in Denmark by 16.5%, in France by 13.8%, while energy intensity on average in the EU-28 countries decreased by 19.3%. Such significant reduction of primary energy intensity in Lithuania was stipulated by dramatic changes in the electricity sector and by the above discussed changes in the country's primary energy balance. Electricity production at the existing Lithuanian thermal power plants fired by natural gas or oil products can increase owing to provisions of energy security, limited possibility to supply electricity at reasonable price from neighbouring countries or other reasons. This increment of fossil fuel consumption for electricity production will cause corresponding increase of primary energy intensity.

Table 2. Primary energy intensity indicators in EU countries, kgoe/thousand EUR

	2000	2005	2006	2007	2008	2009	2010	2011	2012
ES-28	170.8	164.0	159.3	151.9	151.0	149.0	151.5	144.0	143.2
Estonia	627.3	502.5	446.1	465.3	469.0	491.6	551.0	505.9	481.5
Latvia	429.4	355.2	332.0	309.6	305.9	357.1	382.4	333.5	328.6
Lithuania	496.3	415.4	377.8	374.6	363.0	389.3	306.8	298.7	291.6
Czech Republic	481.9	431.2	413.5	391.0	370.8	363.9	374.5	355.4	355.4
Poland	427.7	378.6	374.3	350.3	336.9	319.8	328.0	314.7	298.8
Slovakia	593.4	494.4	452.6	387.6	375.7	362.2	369.3	349.3	329.3
Denmark	101.6	94.4	98.2	94.3	92.6	94.1	97.5	89.7	87.2
Germany	159.1	153.7	152.4	140.1	140.3	138.9	140.5	129.2	129.2
Finland	238.1	219.3	228.5	215.6	206.8	213.1	225.8	210.2	204.0
France	162.6	160.9	155.0	149.9	150.9	148.9	150.7	142.6	142.9

Source: Eurostat (2014)

Application of the primary energy intensity indicator gives a possibility to assess overall energy efficiency of all energy sources in all stages of energy consumption starting from extraction or import of primary energy

sources, their transformation, transmission, distribution and final consumption. Changes in primary energy intensity reflect trends in the actual changes of energy efficiency in each country. Therefore, this indicator is used in many studies prepared by the International Energy Agency, the European Commission, etc. and is regularly published in statistical publications and periodically updated in the Eurostat database. The comparative analysis of primary energy intensity is often used to evaluate the energy saving potential of individual countries. Based on the data presented in Table 2, a conclusion about very large energy saving potential in Lithuania and in other Central and Eastern European countries could be made. For example, in 2012, primary energy consumption per unit of GDP (measured in thousands of euros) in Estonia was by 3.4 times, in the Czech Republic by 2.5 times, in Latvia by 2.3 times, in Poland by 2.1 times, in Lithuania by 2.0 times, in Finland by 1.5 times higher than the average in the EU-28 countries. However, these energy intensity indicators are defined in different countries applying the principle of established exchange rates between national currencies and the euro. High energy intensity in Central and Eastern European countries is determined to a large extent by the low level of GDP compare with developed EU countries. Therefore, such an assessment of the potential savings is not correct because the real possibility for reduction of relative primary energy consumption per unit of GDP is much lower (Miškinis *et al.* 2013).

When comparing indicators of primary energy intensity in various countries, it is necessary to pay attention on two important aspects: 1) the size of this indicator is determined not only by the amount of energy consumed but also by the value of national GDP, 2) the indicator of primary energy intensity is highly dependent on the specific features of the country's energy sector, structure of energy transformation sector, own use of the energy sector, ratio of electricity import and export and non-energy consumption.

Method of Purchasing Power Parity is used when seeking to compare correctly levels of GDP per capita in the industrialized and developing countries. These indicators are based on capability to purchase the same amount of goods and services in different countries. This principle should be certainly applied to the determination of energy intensity indicators, i.e. GDP in all countries should be converted from national currency into a single international currency (euro or U.S. dollars at constant prices) using estimates of Purchasing Power Parity. Differences of the national GDP using exchange rates and GDP using Purchasing Power Parities in industrialized countries are comparatively small. Meanwhile, GDP in developing countries, given in Purchasing Power Parities, are by 1.5-2.5 times higher compare with GDP using exchange rate. Therefore, indicators of the primary energy intensity determined applying these two methods in developing countries are very different (Table 3).

Table 3. Indicators of primary energy intensity

	kgoe per thousand 2005 USD, exchange rate			kgoe per thousand 2005 USD, using PPP		
	2000	2005	2011	2000	2005	2011
World	254.1	251.0	249.0	208.5	198.4	185.9
OECD	164.2	154.0	138.7	167.5	156.4	139.9
EU-28	137.5	132.3	115.8	143.8	137.4	119.6
Estonia	508.0	404.2	408.6	315.1	252.0	255.0
Latvia	357.8	287.0	267.7	190.3	153.1	143.1
Lithuania	396.8	335.0	241.8	212.1	179.6	129.5
China	709.4	702.0	619.7	310.7	304.8	266.6
USA	203.7	184.6	165.7	203.7	184.6	165.7

Source: International Energy Agency (2012, 2013a,b)

The data shown in the Figure 3 illustrates changes in the primary energy intensity in China, the world, the United States, the EU-28 and Lithuania over the period 2000-2011. Presented indicators demonstrate really

existing differences of energy efficiency in various regions. In 2011, primary energy consumption per unit of GDP in Lithuania was by about 10% higher than the average in the EU-28 countries, but by about 40% less than the global average, and twice less than in China.

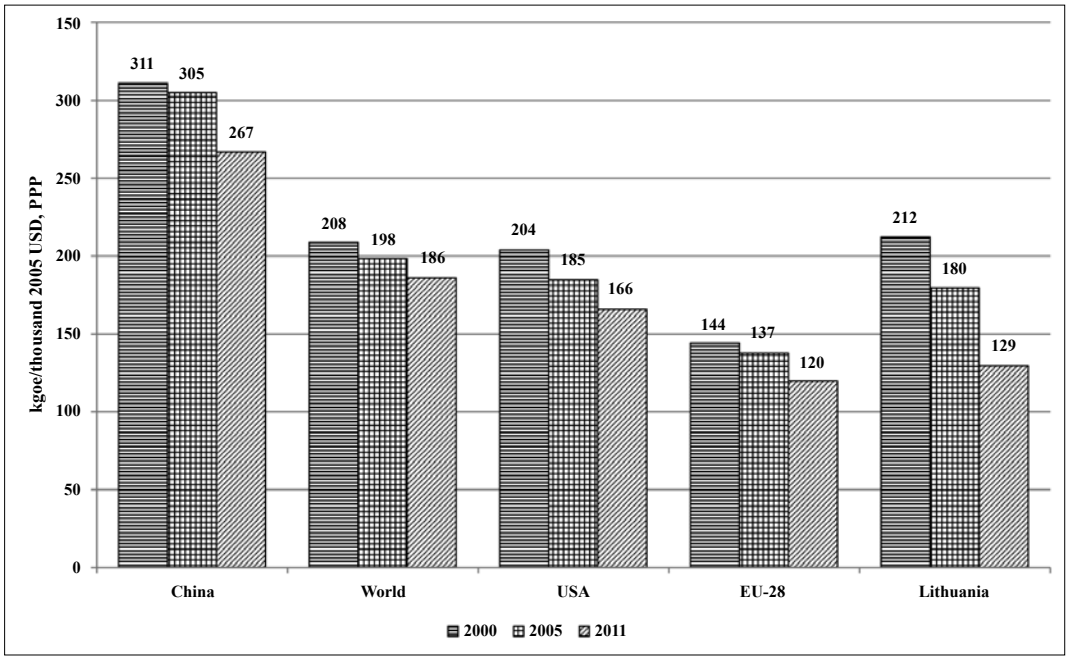

Fig.3. Indicators of primary energy intensity

Source: International Energy Agency(2012, 2013a,b)

Further reduction of primary energy intensity in Lithuania in medium-term period depends very much on common efforts in all sectors of the national economy directed to reduction of the final energy intensity, i.e. depends on real implementation of energy efficiency measures at consumer side. Significant effect in energy saving can be achieved by modernization of: multifamily houses and public buildings, individual buildings that not connected to district heating systems, individual solid fuels boilers, internal domestic heating systems in households, etc.

4. Energy in the National Defence System

Modern energy security is one of the constituent parts of the worldwide security. Energy security is a possibility to guarantee an uninterrupted energy supply to consumers at affordable prices, maximum energy efficiency and a rational balancing of the activity of separate energy systems (Lankauskienė, Tvaronavičienė 2012; Vosylius *et al.* 2013).

During the recent years, energy security issues have been included into many agendas of world-level debates as particularly important due to several factors posing a threat of armed attacks on the supply of energy resources and their sources. Physical disturbances in the energy supply can be caused by terrorism, pirate attacks at sea, political instability in the countries having large energy resources as well as attempts of individual countries to employ the supply of energy resources for political blackmail (Uberman, Žiković 2014; Wahl, Prause 2013; Lankauskienė, Tvaronavičienė 2012; Vosylius *et al.* 2013; Garškaitė-Milvydienė 2014). All these factors are not a direct military threat but they pose a danger for the independence of the states having scarce domestic energy resources.

The NATO alliance incorporates diverse countries with the total population of about 900 million. The document of particular importance “Strategic Concept for the Defence and Security of NATO Countries” (NATO

2013), approved in 2010, highlights: "All countries are increasingly reliant on the vital communication, transport and transit routes on which international trade, energy security and prosperity depend. They require greater international efforts to ensure their resilience against attack or disruption. Some NATO countries will become more dependent on foreign energy suppliers and in some cases on foreign energy supply and distribution networks for their energy needs. As a large share of world consumption is transported across the globe, energy supplies are increasingly exposed to disruption". Conflict-type situations are triggered by tensions related to an excessively great dependence of individual states or regions on the supply of strategic raw materials and energy sources from countries which are politically unstable or are ruled by non-democratic regimes. Threats to energy security can be posed by both restrictions on meeting increasing energy needs because of dwindling global oil and gas resources and the increased geopolitical role of states exporting energy sources as well as leverages to dictate terms to energy importing countries. When threats emerge in any country of the NATO alliance, they are comprehensively analysed and a common position for their neutralization is prepared.

The NATO alliance is determined to develop capabilities and contribute to energy security, including the safeguarding of the critical energy infrastructure, transit zones and lines, cooperation with partners and consultations among the members of the Alliance concerning the strategic assessment of the emerged problems and, in a case of genuine threats, preparation of defence plans. Active and efficient policy of the EU also significantly contributes to common security within the Euro-Atlantic area.

In many EU states, the Army, among other state sectors, is attributed to the structures consuming the most of energy resources. According to the data by European Defence Agency, the Armed Forces of a single state consume on average as much electricity as one large city. The total energy consumption for military purposes of all the states participating in the activity of this agency equals that of a small EU state (Energy efficiency 2013). Because of the dwindling traditional fossil fuel resources alongside the simultaneously increasing strictness in the requirements which are applied to all technological structures concerning their harmonious functioning with the nature, increase in the energy efficiency is becoming one of the most important directions in the sustainable energy development (Baublys *et al.* 2011; Juozaitis 2013).

Energy efficiency is very important for both the NATO alliance countries and also their military structures. At present, a detailed analysis is being conducted concerning the possibility of military structures to contribute to the effective use of energy sources by introducing smart technologies, improving the accounting for energy consumption, investing in various energy-effective appliances and transport, decreasing energy losses in buildings as well as more extensively using renewable energy sources. Until 2010, the issues of the effectiveness of the consumption of energy sources, their prices, supply and security in essence were not properly analysed in the NATO alliance countries, among them in the Lithuanian National Defence System. However, the recently published NATO documents and the mentioned energy efficiency study, prepared in 2013, testify that issues pertaining to the increase in the energy efficiency are not only attributed to the most important directions of harmonious energy development but their significance is also highlighted in defence documents, plans and further research in this area is planned.

The purpose of the recently established in Lithuania **NATO Energy Security Excellence Center** is to organize research on issues of energy supply security and energy efficiency in military structures. On the initiative of this Center and under the commission of the National Defence Ministry of Lithuania, the first energy efficiency study was carried out (Energy efficiency 2013). On the basis of this study it is planned to conduct research concerning investments and other long-term decisions, ensuring a consistent increase in efficiency of energy consumption within the National Defence System.

The Lithuanian National Defence System has other organizational and technical problems associated with the exploitation of energy objects, saving of energy sources, their systematic accounting and effective consumption. It is equally important to improve the qualification of the personnel dealing with the management and exploitation of energy objects.

In order to eliminate the present shortcomings in the Lithuanian National Defence System, it is necessary:
1) To create an organizational group with the aim of formulating provisions for rational use of energy sources and to define the goals and tasks for the increase in the effectiveness of energy consumption.
2) To establish and truly implement the energy consumption management system, i.e. to organize and execute the planning of energy consumption, the preparation, checking and monitoring of action plans, the creation of energy accounting data base as well as the assessment of the achieved goals.
3) To differentiate energy accounting according to the categories of the end-users of the National Defence System. This will create conditions to determine more accurately the effectiveness of the final energy consumption and choose adequate energy saving measures.

Conclusions

Lithuania and other Baltic countries have a vision of rapid economic growth for the medium and long-term period, and the desire to reach in terms of GDP per capita in Purchasing Power Standards the current EU-28 average. Economic growth may cause a moderate growth of primary energy demand in the Baltic countries. Energy demand growth rates could be reduced by modernization of: multifamily living houses and public buildings, individual buildings which are not connected to district heating systems, individual solid fuels boilers and internal domestic heating systems in households, as well as by implementation of other energy efficiency measures in all sectors of the economy.

Energy efficiency is very important for both the NATO alliance countries, as well as their military structures. Military structures can contribute to energy efficiency by implementing smart technologies, by improving accounting for consumption of energy sources, by investing in various energy effective appliances and transport, by reducing energy losses in buildings, by more extensive use of renewable energy sources.

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