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ENERGY ECURITY AND LONG-TERM ENERGY EFFICIENCY: CASE OF SELECTED COUNTIES

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Abstract. Sustainable development of separate regions and countries is affected by array of factors among which energy security plays a cricial role. We claim, that efficient use of energy is very important constutuent of energy security. The first part of the presented paper we wil devote to overview of perception of energy security and revealing waht role energy efficiency plays. Energy efficiency could be estimated by energy intensity indicator, which shows what ammount of energy is used for e.g. one European Euro. This indicator can be calculated for main sectors of economy: various branches of industry, services and agriculture. The higher value added is created in the sector, or, to put it in onother way, the higher activity of sector, the more important that energy in this sector would be used efficiently. In this paper we tackle long-term activity and energy efficiency of agriculture sector in developed and less developed countries.We raise an assumtion that in better developed countries activity of agricultural sector in long-run would diminish, what would be followed by gradular increase in energy intensity; i.e. energy intensity indicator would gradually diminish. Besides, we assume that those tendencies would be slightly different in currently less developed countries; i.e. agricultural sector not necessarely would contract and energy intensity would diminish with higher rates if to juxatopse with better developed countries. In order to verify raised assumptions data of the selected European countries will be used. Better developed countries would be represented by one country – Germany. Less developed European countries would be represented by Bulgaria and Romania. We will forecast activity and energy intensity by using LEAP software. Indicated data for chosen countries will be forecated untill year 2050. Obtained results will indicate if consitent patterns could be traced and respective policy implications formulated.

Keywords: sustainable development, energy intensity, agriculture, long-term forecasting

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JEL codes: Q4; Q47

1. Introduction to energy security dimentions

There is a lot of scientific literature devoted to various facets of sustainable development. One significant strand is research is devoted to interrelation of sustainable development and energy security, interrelation of sustainable development and efficient energy use in various areas of economic activity (Vosylius et al. 2013; Janda et al. 2013; Mačiulis, Tvaronavičienė 2013; Dudzevičiūtė et al. 2014; Dezellus et al. 2015; Balitskiy et al. 2014; Kalyugina et al. 2015; Tvaronavičienė et al. 2015, Strielkowski et al. 2017).

It needs to be noted, that there is unanimous agreement that efficient use of energy is one of significant constituents of sustainable development. Total energy efficiency of any country is determined by composition of economy (Lisin and Strielkowski 2014; Lisin et al. 2015). Economy of each country is comprised by industry, service sector and agriculture, if to take this structure in generalized way. The listed sectors of economy are characterized by different energy intensity. Let us recall that energy intensity indicator is used for estimations of energy efficiency. Hence, energy intensity in different sectors of economy depends on technological process, composition of goods produced or services provided, technological level of production, behavioral patterns of energy use and many other factors (Ehrenberger et al. 2015). The main task for any economy is to achieve diminishing of energy intensity in all sectors.

2. Genesis of energy security perception

In the introduction we claimed that energy efficiency was one of the most important factors impacting energy security. Alas, energy security is defined much broadly; authors argue what sets of indicators suit the best for reflection of this phenomenon. Let us immerse ourselves into this discussion. Hence, when entering this debate, it seems important to focus on the scope of relevant literature and to concentrate on the latest papers in the area. For instance, Cherp & Jewell (2014) describe energy security conceptualization and very clearly indicate that *"energy security should be conceptualized as instance of security in general*" (Cherp & Jewell, 2014). This approach is absolutely compliant with our approach and our intentions regarding the main aims and objectives of this paper. We believe that energy security should be conceptualized perceiving it as constituent of security. The width and complexity of the area of energy security and efficiency, within which eclectic energy security facets are being indicated is a complex matter. It is obvious that security facets ("security for whom", "security from what threats" are being intertwined with generic sustainable development facets: "security for which values", and all "4 A's" referred to as availability, accessibility, affordability, and acceptability. Distinguished facets of energy security partially overlap - "security for which values" and "acceptability" are dependent on energy policies, which again, could be estimated only after agreeing what common methodological platform is acceptable for all discussing parties. Here one needs to mention that energy security facets have been and are still transforming over time. E.g., Cherp & Jewell (2014) underline the following questions, which should be addressed by concept of energy security: Security for whom?", "Security for which values?" and "Security from what threats?". Admitting the importance of these questions, the authors are more inclined to use, as they call " influential approach – the "four A's of energy security" (represented here by the availability, accessibility, affordability, and acceptability) (Cherp & Jewell, 2014). Based on the review of the relevant literature, Cherp & Jewell (2014) draw attention to different periods, characterized by different contexts of energy security perception. One, early period, dates back to the age of oil price shocks of the 1970s. The 2000s are indicated as yet another period which is characterized by issues of different origin. Increasing demand for oil in Asia, as well as Europe's dependency on gas and environmental degradation due to increase in energy use also become problems worth sparing a closer look. Hence, energy availability and affordability represent the classical, or early characteristics of energy security, while affordability and acceptability may be conditionally called "new" characteristics, which are introduced in attempt to address contemporary issues of global development, such as increasing demand of energy, triggered by increasing population and respective increase of economic activities.

The way how researchers, politicians and other stakeholders introduce new dimensions is vividly described in a research paper entitled "Three blind men and an elephant: The case of energy indices to measure energy

security and energy sustainability (Narula & Reddy 2015). The paper compares three different indices, namely the 'Energy Sustainability Index', 'International Index of Energy Security Risk', and 'Energy Architecture Performance Index' along with their variants to examine if they provide consistent results for various countries. A comparative assessment reveals that the three indices provide different country rankings, which are inconsistent. This situation is akin to three blind men groping the elephant with each one measuring a different part of the body and asserting that only their assessment is true" (Narula & Reddy, 2015). A summary of different indices and their major differences is shown in Table 1.

Table 1. Comparison of energy indices

	EAP index	**ES risk index**	**ESI – 2013**
End goal	To measure the performance of global energy systems to meet the objectives of providing a secure, affordable and environmentally sustainable energy supply	To measure the risk to overall energy security	To rank countries in terms of their likely ability to provide a stable, affordable and environmentally sensitive energy system
Dimensions	3	4	6
Core dimensions	'Economic growth and development', 'environmental sustainability' and 'energy access and security'.	Geopolitical, economic, reliability, and environmental factors	Energy performance: Energy security, social equity, and environmental impact mitigation Contextual performance: Political, societal and economic strength
Indicators	18	29	23

Source: Narula & Reddy (2015)

Some authors claim, that energy security as concept is context sensitive. Therefore, some analysts who study energy efficiency from long-term prospective claim that stability of energy supply is more important than cost-effectiveness (Månsson et al. 2014) . Despite various approaches towards perception of energy security could be found, we will focus on efficient use of energy, since scare resources have to be employed efficiently.

3. Long-term energy intensity change

In the presented paper we will make analysis of lon-term tendencies energy efficiency estimated by energy intensities in European countries of currently different development level. We will takle agricultural sector reflecting to an issue of food security (Ryabchenko et al. 2017; Svetlanská et al. 2017; Azamatova et al. 2017; Azimova et al. 2017).

We seek to verify two raised hypotheses.

We raise a hypothesis that in better developed countries activity of agricultural sector in long-run would diminish, what would be followed by gradular increase in energy intensity; i.e. energy intensity indicator would gradually diminish.

Additionally, we assume that those tendencies would be slightly different in currently less developed countries; i.e. agricultural sector not necessarely would contract and energy intensity would diminish with higher rates if to juxatopse with better developed countries.

2. Research methodology for forecasting energy intensity in long run

In order to reveal long-term tendencies of energy intensities change of we will look at agricultural sectors of highly developed European country – Germany and two less developed countries – Bulgaria and Romania. Our aim to juxtapose better developed and less developed European countries in order to verify if consistent patterns could be traced. We will forecast level activity of agriculture and energy intensities of agricultural sectors in those selected countries until year 2050.

Long term forecasting instrument: for long term forecasting we will use LEAP software (Heaps 2016). Currently available statistical data are already incorporated into LEAP software, we need to decide what changeable indicators to choose. There is possibility to make the following assumptions: pattern of change of GDP growth, overall economy's energy intensity change; population growth, economy structure change, specifically, changes of value added growth in agriculture, services, industry, manufacturing and construction. Besides it is possible to set Gini index, transportation mode shares (air, rail, and road) and electric generating capacity (solar, geothermal, hydro, wind, nuclear, thermal, tide and wave). Hence, we see, that a lot of options for multi-variant modeling is provided. In order to set one or another conditions we need to provide respective argumentation. Only in that case obtained scenarios would have appropriate value for decision makers while choosing one or another economic policy. In our research we have purpose to observe trends in energy intensity of agricultural sector of selected countries in case we maintain current conditions. Therefore our forecasting is based on current trends, and we use *ceteris paribus* assumption, as it was already indicated. Of course, there are research limitations, since conditions can change and then our forecasting would not provide sufficiently precise trends. Anyway, we believe that modelling should be the next step, which followed after trends based on ceteris paribus assumption is analyzed and interpreted.

4. Results of forecasting and their interpretation

Forecasting using LEAP software allowed us to obtain the following results. Activity of agricultural sector in Germany in long-run would graduly diminish, as it was formulated in the first hypotheris (Figure 1). Energy inrensity as will would gradually dimish (Figure 1), what as well veryfies the first hypothesis. Here we need to note, that scrupulous reader can raise a question, how one taken country could veryfy or deny assumption about long-run tendecies further development of currently developed countries. Here we need to explain that former extensive reseaches suggeted that developed countries do not differ much in their long-term behavioral patterns (e.g. Tvaronavičienė 2016, 2017). We agree, that availability of just one country, which as we assume, represent a whole cohort of developed countries, is obvious research limitation. Further, we claim, that since developed countries demonstrate very similar development tendencies, this research limitation should not considerably affect obtain results and not deteriorate formulated generalizations.

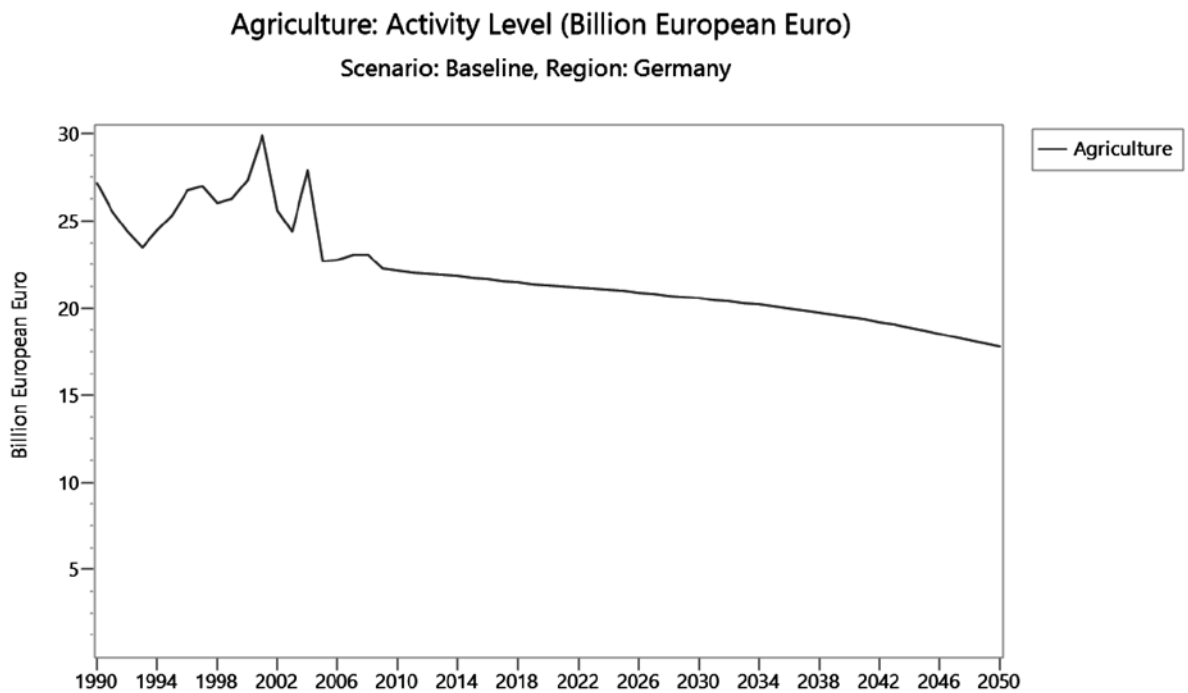

Figure 1. Long-term tendencies of activity of agricultural sector in Germany

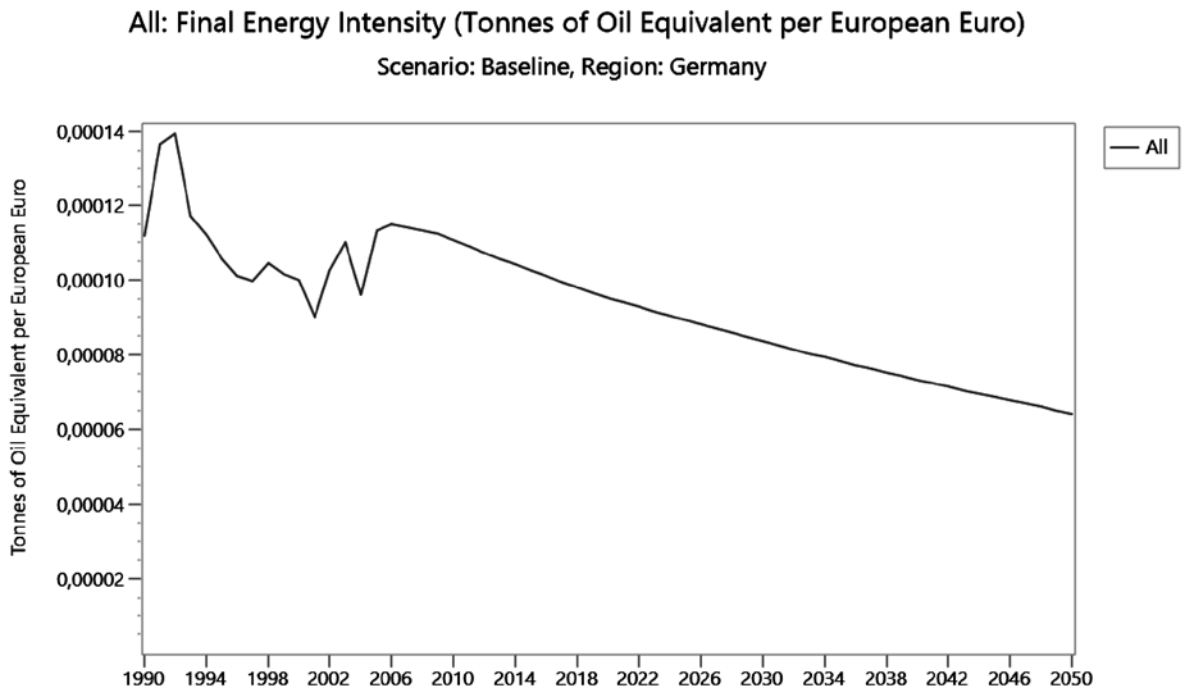

Figure 2. Long-term tendencies of energy intensity of agricultural sector in Germany

After we verified the first assumption, let us examine forecasting results of currently less developed countries, which in our research are represented by Bulgaria (Figure 3 and Figure 4) and Romania (Figure 5 and Figure 6).

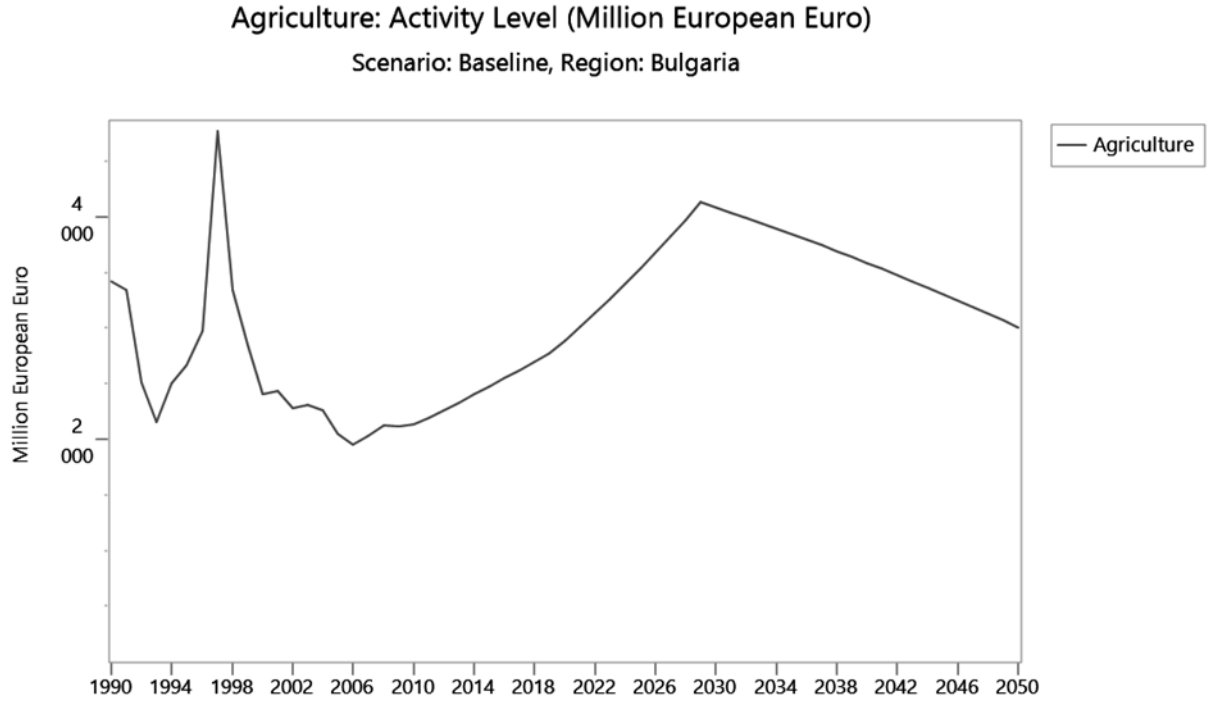

Figure 3. Long-term tendencies of activity of agricultural sector in Bulgaria

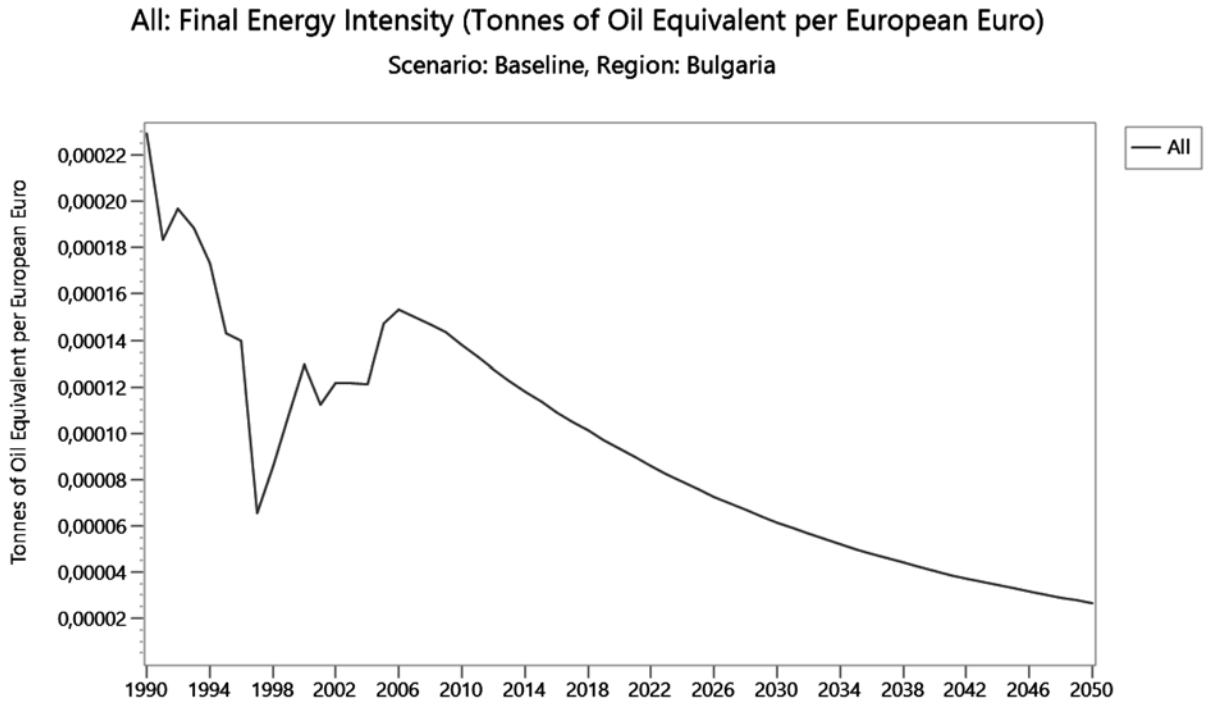

Figure 4. Long-term tendencies of energy intensity of agricultural sector in Bulgaria

Forecasting results of agriculture activity in Bulgaria and Romania in long-run, i.e. until year 2050 (Figure 3 and Figure 5) allow us to formulate an insight about obvious similarity of change tendencies among those countries. At the same time it needs to be pointed out, that there are vivid difference among those countries and currently better developed countries, which in our research is represented by Germany (Fig. 5). If agricultural sector activity gradually diminishes in the latter country, Bulgaria and Romania demonstrates fluctuation, which might signal of structural changes of their economies.

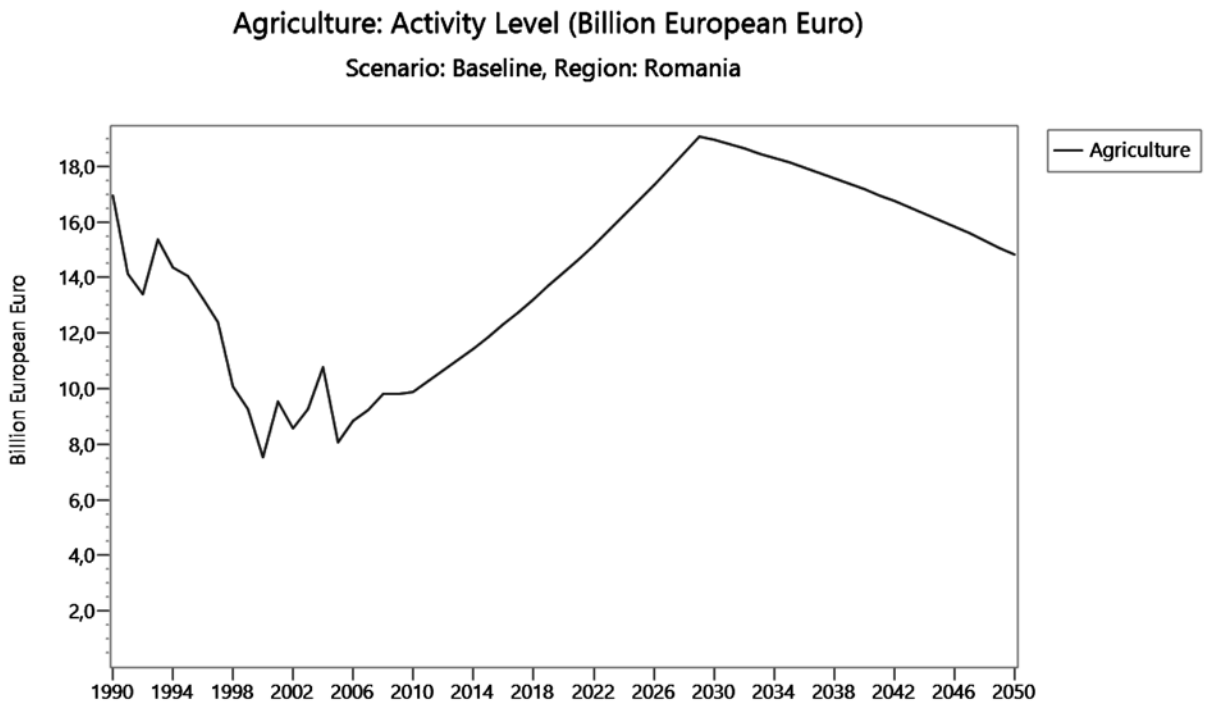

Figure 5. Long-term tendencies of activity of agricultural sector in Romania

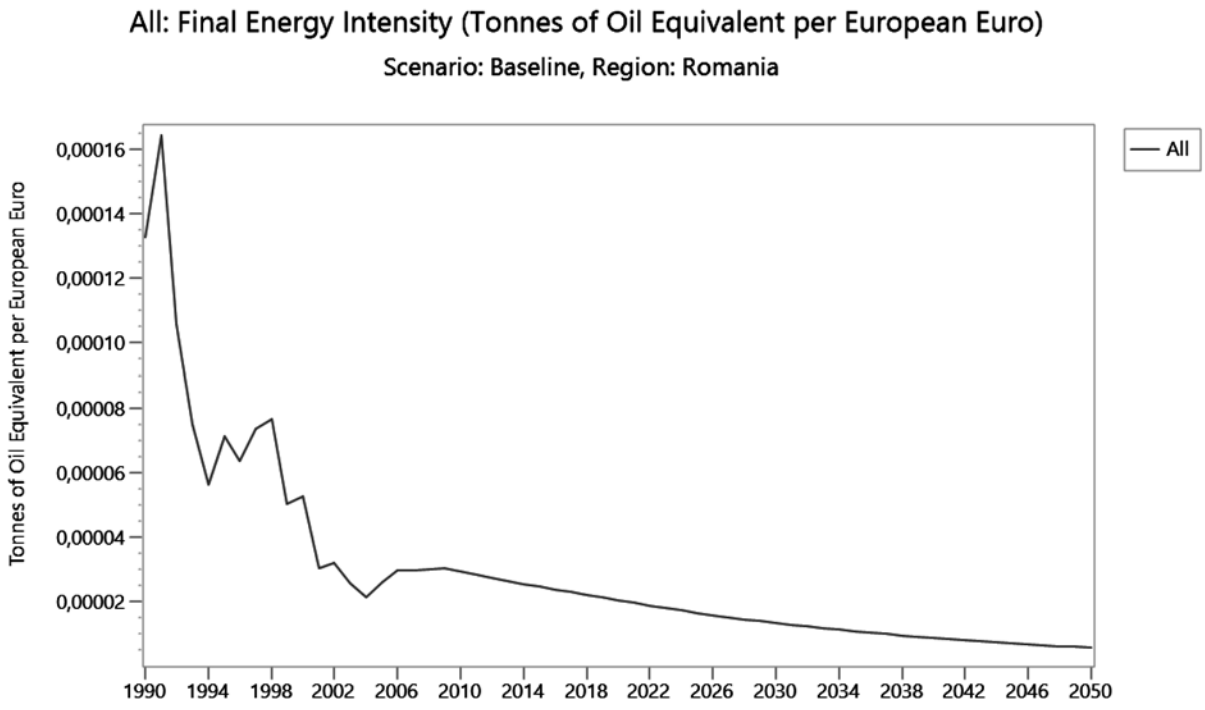

Figure 6. Long-term tendencies of energy intensity of agricultural sector in Romania

Forecasted energy intensities tendencies in agricultural sector of Bulgaria and Romania (Figure 4 and Figure 6) are of similar character therefore could be treated as consistent patterns.

They considerably differ from forecasted energy intensity change in Germany (Figure 2), what could be recognized as evidence verifying the second hypothesis.

Conclusions

Perception of energy security is context sensitive and therefore has changed reflecting to political issue. Irrespective to treatment of energy security as complex phenomenon, energy efficiency remains important factor affecting level of energy security of any country and any sector of economy.

Analysis of energy intensity of agricultural sector of differently developed European country allowed to come to following insights, reflecting to hypotheses raised.

It is expected that in long-term agricultural activity would gradually contract in currently better developed countries; energy intensity in agricultural sector should gradually diminish as well.

Currently less developed European countries should *ceteris paribus* demonstrate different patterns of agricultural sector development: activity of agricultural sector would fluctuate, while energy intensity would diminish significantly.

Similar consistent patterns might be characteristic to other countries of similar development level. Obtained results might be beneficial for formulation of policy implications for long run.

References

Azamatova, R.; Shadova, Z.; Shorova, B. 2017. Economic security and international relations in the European Union, Journal of Security and Sustainability Issues 6(4): 711-718. https://doi.org/10.9770/jssi.2017.6.4(15)

Azimova, S. T.; Kizatova, M. Z.; Akhmetova, S.; Donchenko, L. V.; Admayeva, A. M. 2017. Towards food security through application of novel scientific findings, Journal of Security and Sustainability Issues 6(4): 719-728. https://doi.org/10.9770/jssi.2017.6.4(16)

Balitskiy, S.; Bilan, Y.; Strielkowski, W. 2014. Energy security and economic growth in the European Union, Journal of Security & Sustainability Issues 4(2): 125-132. http://dx.doi.org/10.9770/jssi.2014.4.2(2)

Cherp, A., & Jewell, J. (2014). The concept of energy security: beyond the four as. Energy policy, 75, 415–421. http://doi.org/10.1016/j.enpol.2014.09.005

Dezellus, E.; Ferreira, L.; Pereira, N.; Vasiliūnaitė, R. 2015. Entrepreneurship conditions: energy resources' Prices and energy consumprion peculiarities in developed countries, Entrepreneurship and Sustainability Issues 2(3): 163-170. https://doi.org/10.9770/jesi.2014.2.3(5)

Dudzevičiūtė, G.; Mačiulis, A.; Tvaronavičienė, M. 2014. Structural changes of economies: Lithuania in the global context, Technological and economic development of economy 20(2) (2014): 353-370 http://www.tandfonline.com/doi/pdf/10.3846/20294913.2014.915597

Ehrenberger, M.; Koudelkova, P.; Strielkowski, W. 2015. Factors influencing innovation in small and medium enterprises in the Czech Republic. Periodica Polytechnica. Social and Management Sciences 23(2): 73-83. http://dx.doi.org/10.3311/PPso.7737

Heaps, C.G. 2016. Long-range Energy Alternatives Planning (LEAP) system. [Software version: 2017.0.4] Stockholm Environment Institute. Somerville, MA, USA. https://www.energycommunity.org

Janda, K.; Rausser, G.; Strielkowski, W. 2013. Determinants of profitability of Polish rural micro-enterprises at the time of EU Accession. Eastern European Countryside 19: 177-217. http://dx.doi.org/10.2478/eec-2013-0009

Kalyugina, S.; Strielkowski, W.; Ushvitsky, L..; Astachova, E. 2015. Sustainable and secure development: facet of personal financial issues. Journal of Security & Sustainability Issues 5(2):297-304. http://dx.doi.org/10.9770/jssi.2015.5.2(14)

Lisin, E.; Strielkowski, W. 2014. Modelling new economic approaches for the wholesale energy markets in Russia and the EU. Transformation in Business & Economics 13(2B):566-580

Lisin, E.; Strielkowski, W.; Komarov, I.; Garanin, I. 2015. Improving the methodology of main power equipment choice for the gas turbine plants. Electronics 19(2): 80-87. http://dx.doi.org/10.7251/ELS1519080L

Mačiulis, A.; Tvaronavičienė, M. 2013. Secure and sustainable development: Lithuania's new role in taking the Presidency of the EU, Journal of Security and Sustainability Issues 3(2):5–13 http://dx.doi.org/10.9770/jssi.2013.3.2(1)

Månsson, A., Johansson, B., & Nilsson, L. J. (2014). Assessing energy security: an overview of commonly used methodologies. Energy, 73, 1–14. http://doi.org/10.1016/j.energy.2014.06.073

Narula, K., & Reddy, B. S. (2015). Three blind men and an elephant: the case of energy indices to measure energy security and energy sustainability. Energy, 80, 148–158. http://doi.org/10.1016/j.energy.2014.11.055

Ryabchenko, O.; Golub, G.; Turčeková, N.; Adamičková, I., Zapototskyi, S. 2017. Sustainable business modeling of circular agriculture production: case study of circular bioeconomy, Journal of Security and Sustainability Issues 7(2) https://doi.org/10.9770/jssi.2017.7.2(10)

Strielkowski, W.; Lisin, E.; Astachova, E. 2017. Economic sustainability of energy systems and prices in the EU, Entrepreneurship and Sustainability Issues 4(4): 591-600. https://doi.org/10.9770/jesi.2017.4.4(14)

Svetlanská, T.; Turčeková, N.; Adamičková, I.; Skalský, R. 2017. Food security facets: case of Slovakia regions, Journal of Security and Sustainability Issues 7(2) https://doi.org/10.9770/jssi.2017.7.2(11)

Tvaronavičienė, M. 2016. Entrepreneurship and energy consumption patterns: case of households in selected countries, Entrepreneurship and Sustainability Issues 4(1): 74-82. http://dx.doi.org/10.9770/jesi.2016.4.1(7)

Tvaronavičienė, M. 2017. Clusters, innovations and energy efficiency: if relationship could be traced, Marketing and Management of Innovations No2: 382 - 391 http://dx.doi.org/10.21272/mmi.2017.2-35

Tvaronavičienė, M.; Černevičiūtė, J. 2015. Technology transfer phenomenon and its impact on sustainable development, Journal of Security and Sustainability Issues 5(1): 87–97. DOI: http://dx.doi.org/10.9770/jssi.2015.5.1(7)

Tvaronavičienė, M.; Mačiulis, A.; Lankauskienė, T.;. Raudeliūnienė, J.; Dzemyda, I. 2015. Energy security and sustainable competitiveness of industry development, Economic research = Ekonomska istraživanja 28(1) (2015): 502-516. http://dx.doi.org/10.1080/1331677X.2015.1082435

Vosylius, E.; Rakutis, V.; Tvaronavičienė, M. 2013. Economic growth, sustainable development and energy security interrelation, Journal of Security and Sustainability Issues 2(3): 5-14, http://dx.doi.org/10.9770/jssi.2013.2.3(1)