

Methods for Enhancing and Evaluation of Energy Security and Economic Growth in Bulgaria

Noncho Dimitrov*

Abstract

Energy security and economic growth are two dependent indicators. Research and the creation of a set of methods designed to monitor the dependencies of these two indicators will lead to sustainable and predictable energy stability in Bulgaria. The assessment of these methods needs to be done by trained and highly qualified experts. Furthermore, the realization that energy supply planning, energy policy and energy security is a continuous process is a prerequisite for introducing innovative and reliable methods for enhancing the economic independence and growth of all sectors in our country.

Keywords: methods, energy security, energy resources, energy, economy, economic growth, evaluation, planning.

JEL: H54, O44, N70

1. Introduction

„No great deed is done by falterers who ask for certainty....”

George Eliot

The energy security and economic growth of the country are related to the thorough consideration of the problem of the rational use of energy resources. High energy

consumption and its consumption, as well as the limitation of energy resources, are a major threat to all sectors in Bulgaria. Achieving a balance between ever-growing population needs and scarce energy supplies can be achieved through efficient energy and fuel consumption, new technology development, and rationalization of non-traditional energy sources.

Ensuring energy stability highlights the responsibility for society, long-term development, lasting cooperation, protection of the natural environment, consumer protection, producer protection, etc. Equal partnerships must be promoted in energy production among all countries in the interest of their energy development, and the availability and the using of energy raw materials has a strong influence on it.

Strategic importance for the global energy balance is crude oil, natural gas and coal, whose exploration and exploitation require considerable resources. The overall consumption in the last decade of the last century has increased more than fourfold, and it is greatest in developed industrialized countries - USA, Japan, Germany, France, Italy and others. The research that have been made have shown that with 1% growth in world economic activity, global energy consumption is on average 0.5% higher. It is expected that in 2020, the quality of life of over 80% of the

* University of National and World Economy, Department National and Regional Security

planet's population depends on the energy resources used.

Energy security and economic growth depend on the development of the national economies of the countries, the growth rates of the different sectors of the economy, the growth of the population of the planet, the amount of exploration of the deposits in the mineral deposits and the constructed mining capacities in the different countries. A key indicator for ensuring the world economy with energy resources is the ratio between inventory volume and yield level. According to the latest estimates, coal reserves in the world are below 900 billion tons, crude oil - under 140 billion tons, natural gas - less than 150,000 billion cubic meters. The International Energy Agency plans by 2020 relate to an expected rising increase in global consumption and a sharp increase in trade in energy carriers and electricity. The global trade in energy commodities will continue to have, over the present century, clear macroeconomic and geopolitical dimensions that are determined by the strategic interests of individual countries and above all by the developed countries, due to the large geographic diversity of the location of world centers of production and consumption of energy resources.

The discovery and utilization of new sources of energy is a long and difficult process involving a lot of costs, the development of fundamental sciences and the development of new technologies. What is more, the efficient use of energy and fuels is in direct dependence on the management of the economy and the scientific and productive activity. Planning as a major energy security function plays a primary role in enhancing

the rational and efficient use of energy and the fuels in the production process.¹ It has a specific feature that is reflected in the system of planning for energy security, energy consumption and energy resources, which in turn will lead to sustainable economic growth.²

Methods for increasing energy security and energy resources, assessing the economic growth in Bulgaria

The establishment of the methodology will help define the approaches and technology for assured and sustainable energy consumption, linking it to the production process and to the energy resources of the country and the region for economic growth.

The continuous process of securing the country's energy security and energy resources is related to the improvement of its elements, which are in mutual connection and interaction. In general, this implies the fixing of such operations and procedures in the implementation of the energy security planning process, energy consumption and energy resources, which, given equal other conditions, ensure the best achievement of the objectives, namely the country's energy security.³

Quantitative and qualitative methods can cover all the variants of an operation in specific circumstances to see and evaluate the results of each option and to determine the timeframes in which they can be realized, as well as the costs and time, needed for that. It should be added that the human factor, which creates problems of psychological and social nature and which do not lend themselves to quantitative measurement, sometimes also has an influence on it.

¹ Bogomilova, E., *Süvremenni instrumenti za otsenka na ekologichnata sigurnost*, UNSS - Izdatelski kompleks, Sofia, 2014, 102-112;

² Tagarev, N., „Aktualni problemi svürzani s analiza na korporativnata sigurnost“, *Spisanie „Infrastruktura i komunikatsii“* Issue 2, № 5, June 2011, 26 -32.

³ Penchev, G., E. Dimitrakieva, „Metodi za mezhdunarodni sravneniya na effektivnostta v otbranata“, „Süvremeneni instrumentarium za otsenyavane na sigurnostta. Analiz na svetovniya i evropejskiya opit“, UNSS - Izdatelski kompleks, Sofiya, 2014, 202-213.

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There are different methods and tools for analyzing, rationalizing and optimizing the energy security planning process in this wide variety of means for improving technology, and those that are methodically developed and can be used in the energy generation process provision have a strong meaning.⁴ Essential for energy security and economic growth are the following:

- Balance method - a traditional method of linking energy security, energy consumption and energy resources. In the system balances, from a methodological point of view, energy balance is one of the most complex issues. It consists of many components of different types of fuels (solid, liquid, gaseous) of energy (electricity, oxygen, heat, etc.) and material balances. All this gives reason to conclude that from all balances the most important one is energy balance;
 - Method of mathematical modelling - it is one of the main methods of scientific knowledge, therefore it has a very wide field of application as a means of reflecting qualitatively different processes and phenomena of the surrounding environment. The mathematical method of energy security refers to its description in some formal language that allows for conclusions to be drawn for some features and components using formal procedures for its description. As long as the mathematical description can be accurate and comprehensive, mathematical methods do not describe real situations but their simplified models. The types of mathematical methods are varied, and they can represent a characteristic of components, defined functional dependencies or graphics, equations describing system movements, tables or graphics, etc. Therefore, the
- Mathematical Method is a system of equations and inequalities, expressed in mathematical formulas, conditions and dependencies through which the main components in the energy security of our country are reflected in varying degrees of detail. It gives a simple reflection of objective reality, but it necessarily reflects the links and the relationships that exist in the process of energy stability under consideration. That method eliminates all secondary or extra details. Each mathematical method can be improved by optimizing its structure and by adding and specifying the input data. The application of the method in the planning of energy security and economic growth only produces the relevant effect when the sufficient and qualitative input and output data are used in the calculations.
- Single energy balance and energy security method - it serves to summarize and interconnect individual private balances, developed by type of energy and fuel (electricity, coal, coke, etc.) and material balances. On the basis of the internal reconciliation of these balances, a quantitative balance is achieved between energy security, energy consumption and energy resources. It takes account of all the elements of energy security and the production process, and is also a system of multiple material and energy balances, which has new analytical properties and raises the efficient use of the information contained in the private balances. Each of the balance sheet indicators has rich information content and therefore their use is of great importance for energy security. It shows that the development of energy security and economic growth must be carried out in strict accordance with the indicators contained therein and

⁴ Dimitrov, D., „Statisticheski izmeriteli, klasifikatsiya i mezhdunarodni sravneniya na prestüpnostta”, Süvremenen instrumentarium za otsenyavane na sigurnostta, Etap 1, Analiz na svetovniya i evropejski opit, UNSS - Izdatelski kompleks, Sofia, 2014., 23-29;

supported by a system of administrative and economic levers. The developed balances of energy security and economic growth can be used in several directions: to ensure internal coherence of the energy security plan; to optimize

energy costs; for the purposes of possible analysis; planning and forecasting. The single energy balance in Bulgaria can be expressed in the System of Energy Balances and Energy Security, shown in the scheme of Fig.1:

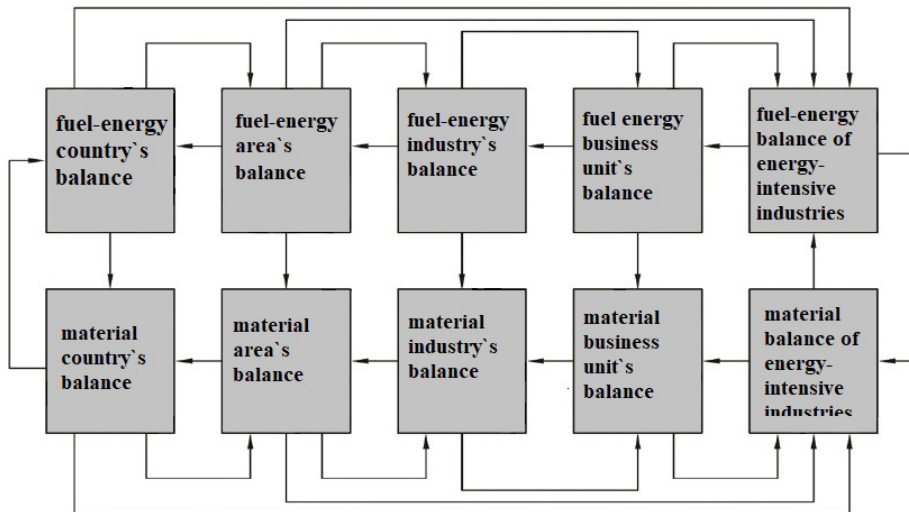


Fig. 1. A system for unified energy balance and energy security in Bulgaria.

What is reflected in the field of analytical use of the energy balance is the actually established in the energy security proportions, interrelations, i.e. the balance report does not create very complex methodological problems in the development. For the construction of a mathematical method of energy balance and energy security, it is necessary to carry out an in-depth qualitative and quantitative analysis of the energy consumption, as only on the basis of it can the most essential relations be exposed to establish the internal system laws. This method presupposes the construction of models based on the theoretical concepts of the behaviour of the studied system, which makes modelling an important tool for experimental research;

- Complex method - The complex function of planning energy security and energy resources can be accomplished through a certain set of methods and tools. On

the basis of the specific tasks of energy security planning, the relevant tasks and the conducted research, a system of methods is developed, the application of which through the planning technology will lead to the realization of the high energy security and energy resource planning function;

- Technical and economic method - shows the indicators that are most closely related to ensuring energy security. Their assessment and analysis are a continuous process driven by the continuity of energy security. The following measurements are possible with natural or conditional measurements. The weight and volume units are used as a natural weight. Coal, coke, fuel oil, oil, etc. are measured by weight units, and by volume-blasting gas, coke gas, natural gas and wood. Developing indicators at the different levels of governance

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requires the use of a single energy and fuel measure;

- Measurement methods - the methods for measuring the development of energy security, energy consumption and energy resources can be grouped into several groups: methods of measuring the absolute level of indicators; methods defining the absolute growth of indicators; methods determining the level of development of indicators and methods establishing relative growth rates;
- Methods of normalization of expenditure - for the normalization of energy security, energy and fuel costs, the following methods can be used: statistical, experimental, experimentally-statistical and research;
- Methods of Economic Analysis - The following system can be used: Comparison - one of the most common economic methods used in the development of the energy security report. Reporting ratios are compared with older plans, those with advanced economies, excellence, mathematical model, etc. The comparison aims to determine to what extent energy security and energy resources are close to the best achievements, and to the

theoretically possible level of efficient use of energy resources;

- The method of the bottlenecks - this method has the leading role of the sectors in the economy. This method is very important for increasing the efficiency of the energy sector as it draws attention to the reserves of energy resources.

Reserves on the rational use of energy resources should be revealed in the process of drawing up the plan for the effective use of these reserves in the process of energy security. A particularly important role for the development of reasoned and optimal plans plays technology, as the implementation of the phases and operations of the energy security and energy planning process according to the prescriptions and with the help of the respective approaches and methods creates the necessary conditions for the development of real and effective plans.⁵

2. Energy security, energy consumption and energy resources planning

Major phases of the energy security planning process and energy resources are shown in figure 2:

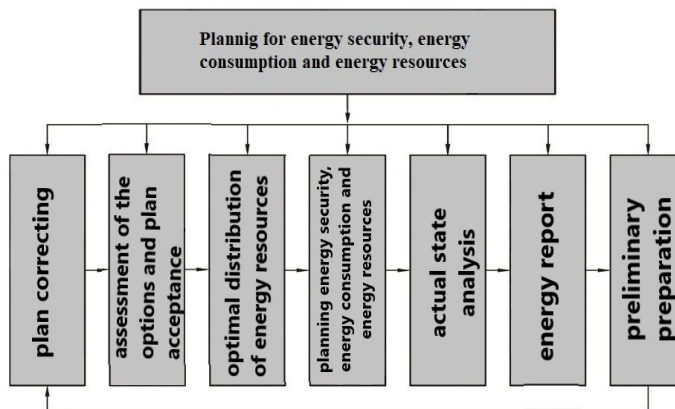


Fig. 2. Phases of energy security and energy resources planning.

⁵ Dimitrov, N., „Antikrizisen menidzhmünt”, UNSS - Man Roli Print, Sofiya, 2018.

The energy security planning phase identifies energy production needs, studying and identifying energy resources and the necessary consistency between energy consumption and energy resources. This phase is realized by establishing energy security, determining the energy consumption and balancing between energy consumption and energy resources. The establishment of the country's energy resources and the full utilization of secondary energy resources are of crucial importance for the planning of energy security. This is determined by the fact that natural energy resources are in limited quantities and they will largely determine the development and improvement of the technology of the highly dependent energy sectors of the economy.

Creating new opportunities for energy and fuel use raises the issue of the rationalization of energy consumption. Streamlining consumption is a discreetly continuous process. The periods during which energy consumption needs to be rationalized are defined by the development of techniques, technology, energy and science. Technical advances lead to a shortening of these periods, which in turn makes them a priority because they are part of critical infrastructure and are also subject to measurement.⁶

Following the planning of the Energy Security Phases, modern evaluation tools should be developed. The approbation of methods for assessing energy security and economic growth goes through the management of organizations in the conditions of competition, crises and conflicts. It is a complex and dynamic process, occurring in a chronic shortage of resources of all kinds. Evaluating the energy security and reforming

the Bulgarian energy sector aims to make it a well-functioning part of the common European energy market. The changes will have an impact on both the energy industry and end users, the fastest action to implement such research will help the sector bottom out of the current crisis it is currently experiencing.⁷ The recommendations of the European Commission pertain to the transition to a fully competitive electricity market in Bulgaria, which will highlight the need for the approbation of such models for security assessments and economic growth. Furthermore, much work is still pending for the full implementation of all legal provisions and its further action on the part of stakeholders.

Assessing energy security and economic growth include a number of indicators that have the long-term goal of creating a competitive environment that will bring down consumer prices. To this effect, it is necessary to introduce new measures and to invest in the modernization of the grid. These changes require significant financial resources that will ultimately be borne by consumers through electricity bills. One of these methods is to stimulate through certificates for all new projects for renewable energy sources.

This method of pricing energy from renewable sources creates opportunities for a new way of planning and action, with a qualitatively new autonomy of structural units. From this point of view, it is a tool for total interaction at all levels and all the structures in the sector to achieve energy supremacy within the sphere of action.

The method for assessing energy security is conditioned by the fact that the energy shortage in Bulgaria is widespread and although nominal prices are the lowest on the

⁶ Dimitrov, N., „Solarniyat biznes v Bŭlgariya“, UNSS - Izdatelski kompleks, Sofiya, 2016.;

⁷ Tsvetkov, Tsv., „Otsenyavane na sigurnostta v protsesa na upravlenie – teoretichni i metodichni vŭprosi“, Izsledovateliski otchet po nauchen proekt na tema „Sŭvremeneni instrumentarium za otsenyavane na sigurnostta, pŭrvi etap – Analiz na svetovniya i evropeŭskiya opit, IK – UNSS, S., 2014, 7 – 22;

continent, they are also among the highest with regard to purchasing power parity. It is also formed by liberalization. In order to ensure that the free market is accessible to all, a number of risks need to be avoided.⁸ In order to ensure free competition between suppliers, distribution system operators should be legally and operationally separated from the vertically integrated companies whose activities include production and supply.

The separation from these companies aims to stimulate the distribution system operator to give access to the network to other manufacturers and/or suppliers as well. The regulator will closely monitor the distribution system operators to ensure that they do not give privileged access to their parent network. This method can be graphically expressed as is shown in figure 3:⁹

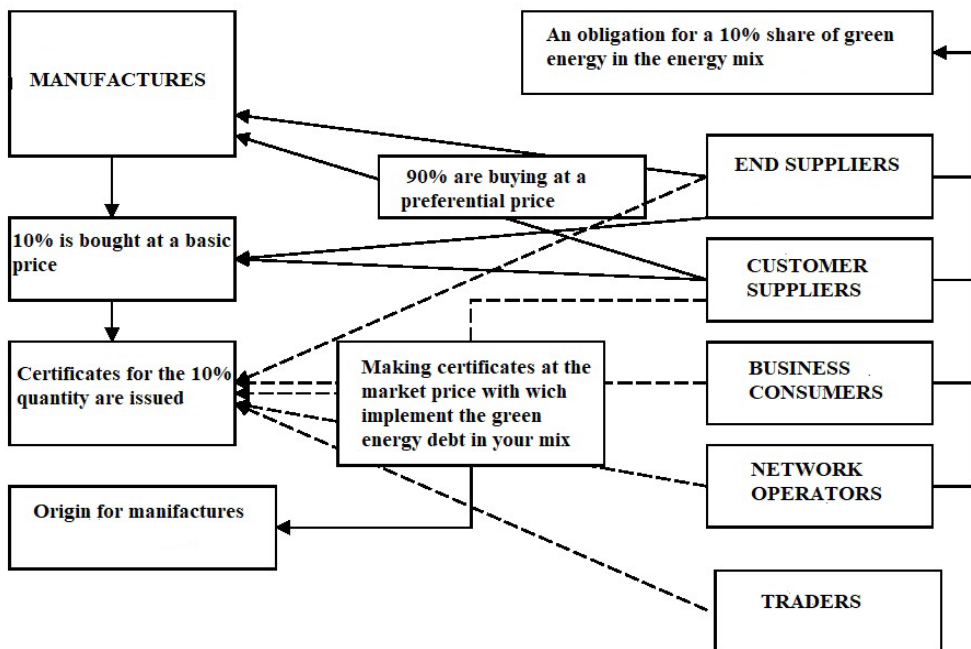


Fig. 3. Stimulation method through certificates.

The theoretical formation of the method to give relevant meaning to assessing the energy security and economic growth goes through the consideration of several key stages such as: the ability as a potential for realization of a certain scenario; the interaction as a mutually bound process; the collaboration as a socio-organizational process of performing collaborative work on elements that interact to

achieve the goals set in accordance with the organizational strategy.

The basic principle, which needs to be subordinated to the method for assessing the energy security and the economic growth in Bulgaria concerns resolving conflicts. Any investment in the energy security system should be geared to the activities of the negotiations, and should be compliant with

⁸ Tsenkov, Y, „Upravljenje na riska v obekti ot kritichnata infrastruktura, Zashitna na kritichnata infrastruktura v ES i Bŭlgariya – ikonomicheski i organizatsionni aspekti“, UNSS - Izdatelski kompleks, Sofiya, 2010.

⁹ Dimitrov, N., „Sŭvremeneni instrumentarium za otsenyavane na sigurnostta - „Model za otsenyavane na energiiinata sigurnost i sigurnostta na energiiinite resursi v Bŭlgariya“, Izdatelski kompleks – UNSS, S., 2017g, 132 – 145

the specifics of the organizations, i.e. the method of assessing the energy security and the economic growth in Bulgaria is a method of investing in energy security.

The logic of the struggle to increase energy security and economic growth in a tightly competitive market has forced the sector in Bulgaria to radically change its strategy. In developed countries, the changed view is that the crucial prerequisite for enhancing energy security is innovation and human potential.¹⁰ In this context, a variety of forms are emerging towards a new method of development that can be defined as a multifunctional security system which includes: orientation towards innovation and innovative technologies as well as highly qualified specialists integrated into the energy system and energy production; continuity of the innovation and qualification financing process; flexibility of the energy sector; sharing responsibilities of state and private organizations in the energy sector and partnerships between energy sector participants. This approach is also taken into account when designing new technologies that ensure the creative participation of a person in their service. Such a method can be effective if it is based on a new control mechanism that takes into consideration the changing energy dependence.

The method for assessing energy security and economic security in Bulgaria reflects the objectively emerging transition to a new energy culture. The need for innovative energy development creates the need for a new concept of energy security, underlying the innovative and creative attitude, which is also part of the national security of our country.¹¹

The effectiveness of the method for assessing the energy security and economic growth in Bulgaria depends on the extent to which the relationship and interdependence between innovation and energy dependency are established. It will provide the necessary knowledge when and where it is needed in a form appropriate to its consumption. What is more, it will focus on the fact that a leading key factor for the development of the energy sector is precisely investing in innovation. In this sense, any investment in innovation is an investment in energy security. The innovation process, as shown by world experience, cannot be confined to the purely technical sphere because it represents a unity of technological, organizational and social innovations, during which a new model for assessing the energy security and security of energy resources is formed.

There is also a specific risk factor in Bulgaria - the quality of management in the energy sector, most clearly expressed in the management of state energy companies and in the way of structuring and managing public procurement, including the mega energy projects in which the government is involved. The financial health of the companies in the Bulgarian Energy Holding is seriously undermined. Part of the problem comes from the administrative control of prices and the frequent and unclear changes in them by the regulator, which led to the accumulation of debts in the two key state-owned companies - NEK and Bulgargaz, respectively in the electricity and gas sectors. Both enterprises are in extremely poor financial condition, making them unprepared for participation in the liberalized market.

¹⁰ Bogomilova, E., „Süvremenni instrumentarium za otsenka na ekologichnata sigurnost“, „Süvremeneni instrumentarium za otsenyavane na sigurnostta“, UNSS - Izdatelski kompleks, Sofia, 2014, 102-112

¹¹ Pudín, K., „Zaplakhi za natsionalnata i regionalnata sigurnost“, Sbornik s dokladi ot Mezhdunarodna nauchna konferentsiya „Globalizüm, regionalizüm i sigurnost“, 19 – 21.09.2013, 232 – 238.

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Managerial deficits in the energy sector are not limited to financial and regulatory conditions but also include human resource management in state-owned companies and the regulator. Frequent shifts in state-owned management teams imply their strong political loyalty and lack of independence in their decisions on the operation of companies. This vicious practice facilitates the takeover of state-owned enterprises from private interests, which ultimately leads to their draining and indebtedness.

From the above, for the solar business, it is important to draw the following conclusions:

- the priority of energy security should not only be security of supply, but also all opportunities for the state to increase its energy independence;
- RES allow us to understand the energy strategy in Bulgaria for assessing the perspectives, providing the necessary information, creating financial stability, modernizing the existing practices;
- in implementation of the EU's Financial Program for Bulgaria until 2013, the Government has adopted some European Commission proposals on RES, which guarantees the purchase of the electricity produced from these sources at preferential prices. This in turn guarantees the return on investment in this area.

The EU has underlined its commitment to international co-operation and combating the effects of greenhouse gas emissions. However, the 1992 proposal on the introduction of a CO₂ and energy tax is still not implemented due to strong opposition from several countries and lack of support from major competitors (US and Japan) on international markets. However, the EU is working hard to reduce emissions.

The European Council called for an Energy Policy for Europe (EPE). It should be based on shared perspectives on long-term demand and

supply, an objective, transparent assessment of the advantages and disadvantages of all energy sources and contribute in a balanced way to its three main objectives:

- enhancing security of supply;
- ensuring the competitiveness of European economies and the availability of affordable energy;
- supporting the sustainability of the environment, continuing the development of renewable energy sources, and implementing the Biomass Action Plan.

The formation of the internal market in the energy sector requires the elimination of many obstacles and trade barriers, approximation of tax and pricing policies, measures on standards, and environmental and safety regulations. To this end, the EU is creating a number of directives on electricity and gas transmission, which aims to open markets to competition.

The increasing dependence of some Western countries on energy imports and their increased energy vulnerability, which creates a favorable environment for future inter-state conflict of resources, is of paramount importance.

Europe is poor on its own energy resources. Production costs for extraction of oil, gas and coal are extremely high. There is significant RES potential but it is not enough to meet industrial demand. The main challenge facing the Community remains the increasing dependence on energy resources. The EU has limited opportunities for response. The dependence on imported resources will reach 70% in 2020 and dependence on oil - 90%. The main importer of natural gas remains Russia, importer of oil - the Middle East. In addition to this dependence, which requires flexible geopolitical solutions, the environmental consequences of the use of organic fuels are compounded.

Europe's dependence on oil imports will increase drastically in the medium term, as output in the North Sea is expected to progressively decrease and be completely discontinued around 2030. Crude oil imports by 2020 are expected to exceed 50% for the EU.

3. Energy Efficiency of Bulgaria.

In 2014, the *Analysis of The Competitiveness of The Bulgarian Economy* paper revealed that Bulgaria's current energy model is unstable in the long term for both the industrial sector and households. Such a system cannot support sustainable growth. There is a significant potential for implementing energy efficiency measures and production of energy from RES to improve the country's competitiveness and increase employment and incomes in small and medium-sized enterprises (SMEs). At the same time, saving energy means utilizing the available energy potential without the need for additional costs.

It is clear from this analysis that Bulgaria has the most energy-intensive economy in the European Union to date. In 2011, the country used 712.4 kilograms of oil equivalent to produce 1 000 euros of GDP, while the average for the EU was only 144.3. Bulgaria has improved its energy efficiency by 2009, the energy intensity index was 664.8, and then went up again. Improvements in this direction are the restructuring of energy demand caused by the shift from heavy metallurgy and chemistry to lower energy-intensive, light industry. This is a stage where, according to experts, any further improvement in energy efficiency will have to be achieved through advances in technology for production, conversion, transport and energy consumption. Such improvements require, on the one hand, the modernization

of the energy system and, on the other, the introduction of RES.

In the area of energy transfer, smart energy networks, more efficient heating networks and other solutions have to be implemented. To achieve this, substantial investments in energy efficiency are needed over the next decade. A major determinant of both end-user behaviour and incentives for energy efficiency investments is the cost of energy.

For the end user, the change in energy policy means total replacement and installation of energy-efficient appliances, purchasing more economical vehicles, improving residential insulation and lighting, and introducing more efficient production technologies and procedures. Bulgaria ranks first among the EU countries with the highest levels of energy poverty. For this reason, increases in energy prices should be supported by a policy of helping the most vulnerable consumers. Future energy efficiency programs should be designed in such a way and on such a scale so as to include vulnerable households. Currently, energy efficiency measures are not taken by most households, not because they are uninterested or uninformed but because they cannot afford the necessary transport and technological improvements.¹² Energy poverty is becoming one of the biggest threats to the national security of the country. To avoid this danger, a better understanding of the specific characteristics of the national economy, regional specificities /Southeastern Europe and the Black Sea region/ as well as the position on EU policies is needed.

Compared to the other EU member states, the population in Bulgaria uses large amounts of coal and wood, as well as expensive electricity to heat their homes, and pays a large percentage of their incomes to cover energy bills (Fig.4), which does not guarantee an adequate living temperature at home.

¹² Georgieva, T, Tsotsorkov, L., Galev, T. i dr., "Analiz na konkurentosposobnostta na bŭlgarskata ikonomika", 2014., 114-115

Restricted access to a particular type of energy infrastructure network (especially natural gas) means that, apart from accessibility issues, the lack of energy is also determined by the spatial and technical constraints associated with switching to cheaper household fuel. Some communities have no choice but to use firewood and coal.

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