

Energy Security and Renewable Sources of Energy

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ABSTRACT

Energy supply is of vital significance for the functioning of the society and represents an important element both of the national and of the international security. The security of energy supply and the protection of energy infrastructure are part of the security concept of the overall critical infrastructure and represent one of crucial preconditions for the development of any community. Energy security is threatened due to the fact that the world reserves of oil and natural gas are unequally distributed, and insecure transport via third countries additionally threatens the security of energy supply. The issue, not only of security but also of the possibility of energy supply lies certainly also in the limited non-renewable sources of energy. The paper will, therefore, consider the possibilities of continuous energy supply in the form of the development of renewable sources of energy.

Key words: *energy security, critical infrastructure, renewable sources of energy*

Introduction

Energy is an important driving force of the economy and all social activities, so energy security represents one of the basic issues of the modern society¹. Energy security is a matter of global security, and thus the matter of national security of each state. Constant and reliable energy supply is one of key prerequisites for the development, therefore, it is not surprising that much attention is directed towards the overcoming of the problem of energy supply. Considering all of the above, the forecasts of any country's economic development are based, inter alia, on energy needs. Energy availability, as well as the efficiency of critical infrastructure, are extremely important for the quality of life of the population, development of the economy and functioning of the public sector of every country. It comprises the ability to supply energy, protection of energy infrastructure, control of prices of energy sources, as well as sustainable management of non-renewable energy sources. Historically, control of energy sources and flows has frequently been the subject of many conflicts and crises, while the increase in oil prices likewise has a great impact on the development of the economy, as well as on the recovery of the global economy. Dependence on fossil fuels such as oil, as well as inefficient use of raw materials contribute to the occurrence of price shocks, and thus threaten the economic security of every country. At the same time, the contribution to climate changes is especially pronounced. The in-

crease in world population will also increase global demand for natural raw materials and create additional pressure on the environment. In the last decade, an increase in production and consumption of various products and services has also been followed by an increase in consumption of all forms of energy sources. Bearing in mind the fact that the sources of oil and natural gas are not limitless, the need arises to develop renewable energy sources which could be a solution in cases of a possible energy crisis. In addition to the security of energy supply itself, one of the main goals of European energy policy is aimed at the protection of the environment through the reduction of energy consumption and an increase in the usage of renewable energy sources. Energy sector also has a significant impact on the environment, whether local, regional or global impact, so energy and developmental issues must be considered within the context of two very strongly interconnected and key issues – energy security and climate change. Climate change and greenhouse gas emissions have become a priority global developmental issue. The main challenge is long-term development of the economy with a reduced emission of carbon dioxide. We seek a more efficient use of energy, use of renewable energy sources, use of energy sources that do not produce greenhouse gases and a more efficient transportation system with an increased use of neutral fuels regarding the emission of CO₂. By using re-

newable energy sources, we improve energy supply security and provide impetus to the development of the domestic production of energy equipment and services, as well as the realization of environmental protection goals². The foundation of the European cohesion policy is the initiative 20-20-20, which clearly defines the Europe of a new era with 20% of energy efficiency, 20% of energy consumption reduction and 20% of renewable sources energy³.

Material and Methods

The goal of the research is to present the challenges of providing energy security based on the analysis of the contents of literature collected, as well as to determine the correlation between the measures of energy security and the measures for the reduction of the impact of energy sector on climate change.

Based on the defined research goal, we set the following tasks:

- Determine the importance of energy security.
- Analyze impacts which could endanger security of the energy system.
- Create a proposal of ensuring sustainability of energy system by using renewable energy sources.

In order to complete individual tasks and realize research goals, the following research methods have been chosen:

- Descriptive analysis method to describe legislation and the perception of energy security.
- Logical scientific method of data collection, processing and drawing conclusions.
- Methods of induction and deduction as a manner of concluding and writing the paper.

Definition of energy security

Opinions differ among security theorists regarding what is meant by security in general. According to some, security means the situation in a community, organization, institution or a specific area, characterized by the existence of a threat or a danger, while others consider security to be activities, measures and actions undertaken by individuals or social groups, organizations or institutions with the aim of achieving, preserving and developing the necessary level of security⁴. Definition of energy security has changed throughout history, and the concept of energy security has over time expanded by including more elements and criteria which need to be fulfilled in order to achieve energy security. A general definition, provided by the International Energy Agency, IEA, is that energy security represents »adequate, cost-effective and reliable energy supply«⁵. According to the above definition, energy security or the security of energy supply is not necessarily equal to independence from energy imports and self-sufficiency, although we can frequently find those two concepts used as synonyms⁶. The model of energy security is not focused only on the solu-

tion of how to deal with a disruption in the supply of oil and natural gas, but rather constitutes a much broader concept related to the protection of the entire energy supply chain and infrastructure⁷.

Results

Security of energy supply

The goal of each state is to ensure uninterrupted energy supply for the purpose of economic development, but also reduce dependence on imported energy sources. In most countries, complete independence on imported energy sources is not feasible due to the lack of their own energy sources. Energy infrastructure and energy transport routes are becoming an increasingly important issue of international security⁸. After the terrorist attacks of September 11, 2001, energy security gained a new dimension in terms of protecting critical infrastructure from possible terrorist retaliation, what has also imposed new ways of thinking. It has become clear that energy security and the protection of critical infrastructure are inextricably linked, that is, they are mutually conditioned⁹. In most cases, current literature from the field of energy security focuses on the problem and evaluation of oil and gas security, geographically directed towards the relationship between economically developed countries and OPEC countries, and mainly discusses these issues in terms of geopolitical relations¹⁰. The reason is surely that numerous problems occur within energy supply due to in equal positions in energy supply, and Russia, the United States and the European Union are world's major players in the field of energy, hence their actions necessarily have global consequences. The position of Russia as an important global actor is defined by the possession of very large energy sources. The United States are one of the largest consumers of energy sources, so the American economy largely depends on energy security, meaning the availability and quantity of oil. As a dominant world power, the United States have established control over certain energy-rich areas, what largely affects energy security of the world, including the rise in energy prices. Therefore, we face the problem of the dominance of states which possess large energy sources and can potentially impose rules on the world market⁹. In terms of energy, the European Union is in a specific situation regarding the high level of dependence on external energy sources since it does not possess sufficient own sources¹¹.

In the Middle East, Saudi Arabia remains a critical oil importer, and in the future Iran may also become this, especially as a gas importer¹².

Bearing in mind that world demand for oil grows and oil sources are limited, it is evident that in the long term the main threat to the energy security represents the depletion of fossil fuel sources. Besides, the possibility of a new energy crisis can be found in the events¹³:

- Developing of some of the current geopolitical crises into a larger conflict or a war motivated by the desire to possess and control oil wells and routes.

- Developing of current political disputes between Russia and the European Union about energy supply from Russia into an open conflict.
- Disruption in the supply of international oil markets caused by a major terrorist attack.

European energy policy

At the turn of the 20th into 21st century, the European Union had sufficient energy. With a certain amount of their own oil and quite a lot of gas in the North Sea, infrastructure has been developed to import oil and gas from Russia, as well as import gas from Northern Africa. Therefore, it is not surprising that European energy strategy has for a long time been based on the assumption that market mechanisms successfully solve supply routes, prices and all dilemmas concerning supply. However, an increase in the demand for oil, as well as new political destabilization of the Middle East led to an imbalance of supply and demand, which further led to a rise in oil prices which altered the relations in the market. The rise of oil prices after 2004 and an increase in the role of gas in the supply of the European Union, as well as the announcement of the Russian Federation on the increase in the geopolitical role of gas, that is, the new politicization of energy created new dilemmas¹⁴.

One of the key security issues currently being posed to the European Union is the issue of energy security, that is, ensuring current and future EU needs for energy in order to maintain economic growth and development of member states¹⁵. European Union has suddenly faced the main energy crisis, this being the dependence on the import of energy, which led to the need of changing energy policy in the European Union. New considerations on the European Union energy policy start from the realization that they affect¹¹:

- Europe's dependence on OPEC countries and Russia
- New uncertainties regarding long-term availability of energy sources
- Uncertainty concerning the supply of fossil fuels
- Uncertainty regarding the development of new technologies
- Questionable acceptability of nuclear energy by the population
- Intensification of measures for the reduction of greenhouse gases.

Nowadays, the European energy policy is based on reduced consumption and secure, more competitive and sustainable energy. Accordingly, the goals of the EU energy policy are: 1) connectivity and proper functioning of the internal energy market, 2) strategic security of supply, 3) actual reduction of the harmful emissions, 4) recognition of the Union as a supranational institution on the world stage¹⁶.

Legal framework of the EU energy sector

Energy policy of the European Union is defined within the framework of other common policies, such as common foreign and security policy, internal market, envi-

ronmental protection, transportation policy and so on, and it relates to the monitoring and regulation of energy demand, as well as the use of the most frequent energy sources – fossil fuels (oil, natural gas and coal), renewable energy sources, nuclear and electrical energy as secondary forms of energy. Guidelines for the development of the energy policy are given in the Green Paper on an European Strategy for Sustainable, Competitive and Secure Energy Supply, the main emphasis being placed on the security of energy supply, environmental protection and industry competitiveness¹⁷.

Main documents that regulate the development of the energy sector at the EU level are:

- White Paper on an Energy Policy for the European Union, December 1995,
- Energy for the Future: Renewable Sources of Energy, White Paper for a Community Strategy and Action, November 1997,
- Green Paper Towards a European Strategy for the Security of Energy Supply, November 2000,
- Green Paper on Energy Efficiency or Doing More with Less, June 2005,
- Green Paper on an European Strategy for Sustainable, Competitive and Secure Energy Supply, March 2006,
- Action plan for Energy Efficiency: Realising the potential – Saving 20% by 2020, October 2006,
- The proposal for European Energy Policy, January 2007.

Guidelines for the development of energy policy provided by the Green Paper on an European Strategy for Sustainable, Competitive and Secure Energy Supply from 2006 were adopted in March 2007 by the European Council. At the same time was adopted a two-year action plan (2007–2009) for the creation of a common energy policy, complemented by new energy measures for the period up to 2014. Action plan for the period from 2007 to 2009 initiated a common European energy policy, which resulted in the adoption of an energy and climate package which turned into the initiative »20-20-20«. The initiative includes 20% reduction in the carbon dioxide emissions, 20% increase in renewable energy sources and 20% increase in energy efficiency¹⁸. The European Union has thus clearly shown that it wants to become a »low carbon« economy with low emissions of greenhouse gases, that is, the global leader in the struggle against climate change¹⁹.

Energy sector of the Republic of Croatia

Energy as a significant driving element of the economy and all social activities represents one of the fundamental issues for each state, including the Republic of Croatia. Energy Development Strategy of the Republic of Croatia is based on three energy²:

- Security of energy supply
- Competitiveness of energy system
- Sustainability of energy development.

Energy strategy focuses on the role of the state in the energy sector, that is, on the determination of its responsibilities in the provision and exploitation of energy sources, ensuring of competitiveness and environmental protection. This includes an active role of the state in the development of energy security as a developmental component of the Croatian economy. Regulation of the energy sector, consumer protection, promotion of energy efficiency, inclusion of the costs of external effects into the price of energy, energy planning and, in that respect, timely intervention to stimulate investment (especially private) in the energy sector are the main instruments of the state energy policy¹⁹.

According to the Energy Development Strategy of the Republic of Croatia (OG 130/09), the security of Croatian energy supply should be significantly improved and the challenges which require special attention are: dependence on oil imports, insufficient security of the natural gas supply and insufficient security or high import dependence of the electrical energy supply².

The geopolitical aspect of energy security is especially prominent in the National Security Strategy of the Republic of Croatia, which states: »Republic of Croatia is located in the area or routes which connect European area with new sources of energy in Asia (Caucasus, Central Asia), routes which connect economically developed countries of Western Europe with industrially undeveloped but resource-rich area of Eastern Europe, as well as the transport routes which connect Central Europe with the Mediterranean and Southeastern Europe. Potential conflicts of interests in the control of transit routes of access to new resources or the acquisition of influence in the areas which are the source of these resources, or the conflicts of interests of states which possess the resources and states in the paths of the access to resources, can lead to the occurrence of wider regional crises, thus opening the possibility of endangering security and stability of the Republic of Croatia.«

Energy sector of the Republic of Croatia is complex and includes seven components: oil, gas, heat and electricity system, as well as energy efficiency, renewable energy sources and nuclear security. Energy sector management in Croatia is, as in almost every European country, highly centralized and monopolized, that is, concentrated in the hands of the state and several major public energy companies. Croatian energy system is mostly in the hands of two state-owned companies: INA group which manages oil-gas system and HEP group which manages electrical and heating system²¹.

Republic of Croatia covers its energy needs through domestic production and imports. Through its own production Croatia currently covers approximately half of its energy needs, which means that half of energy is imported, whereby the trend is that this figure deteriorates with an increase of import dependence in the future. There has been a continuous increase in dependence on energy imports from 1991 until today, so it is assumed that the dependence on imports shall in 2030 be over 70%¹⁷.

Figure 1 shows the development of the total energy consumption in the period from 1988 to 2010. Compared to the previous year, the total energy consumption in 2010 has increased by 0.8 percent. In the period from 2005 to 2010, we can observe stagnation in the total energy consumption with minor changes per individual years. From 1992, when a minimum of total consumption has been realized in Croatia, the total energy consumption grew at an average annual rate of 1.8 percent by the year 2010¹⁷.

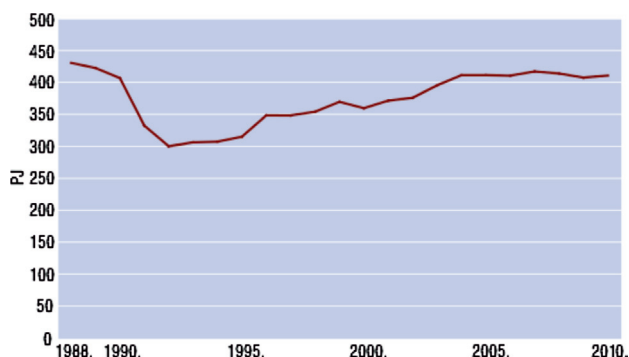


Fig. 1. Total energy consumption in the Republic of Croatia²².

In the period from 2005 to 2010 the development of the production of individual primary forms of energy was such that the share of crude oil decreased from 20.3 to 13.4 percent, and the shares of all other forms of energy were increased. Due to the extremely favorable hydrological conditions, the share of hydrological power increased for 3.4 percent and thus amounted to 34.9 percent in 2010. The share of natural gas increased from 40.3 to 41.1 percent, and the share of firewood increased from 7.6 to 8.7 percent. The share of other renewable energy sources (wind energy, biodiesel, solar energy, geothermal energy, landfill and biogas) increased to 1.1 percent in 2010, and the share of thermal energy from heat pumps increased to 0.7 percent²². The shares in the primary energy production in 2010 have been shown in Figure 2.

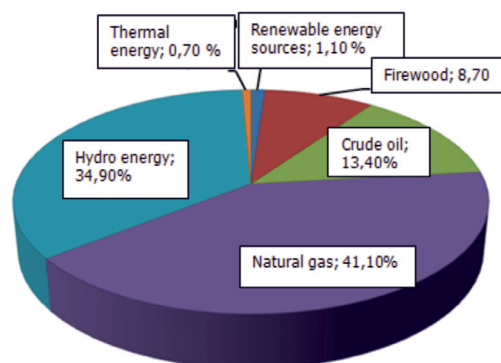


Fig. 2. Shares of the primary energy production in the Republic of Croatia in 2010²².

In Croatia, the own energy supply (the ratio of total primary energy production and total energy consump-

tion) in 2010 amounted to 55.5%, or dependence on imports amounted to 44.5%, while the total primary energy production in 2011 decreased compared to the previous year. Due to unfavorable hydrological conditions, the was reduced by as much as 46.6 percent. Likewise, production was reduced by 9.4 percent, by 7.6 percent, as well as produced using heat pumps by 1.7 percent. Production of firewood and biomass, as well as other renewable energy sources has been increased. Production of firewood, wooden biomass in industry, energy of wood pellets and briquettes, as well as charcoal energy has been increased by 34 percent compared to 2010, and the total energy production from other renewable sources by 13.3 percent. Due to the significant decrease in the production of primary energy, own energy supply amounted to 48.9 percent in 2011, what is 6.6 percent less compared to the previous year²².

Liquid fuels or petroleum products are the main source of energy in the Republic of Croatia. With current oil consumption of approximately 1 t/capita in total energy consumption, Croatia is close to developed European economies. It is estimated that the average increase in liquid fuels consumption in direct consumption, despite all energy efficiency measures, annually amounts to 0.9% and that the total consumption in 2020 will amount to approximately 4.3 million tonnes²².

Renewable energy sources

Renewable, inexhaustible or alternative energy sources on Earth originate from three main primary sources²³:

- Disintegration of isotopes in depths of the Earth (e.g. geothermal energy)
- Gravitational effects of the planet (e.g. tidal energy)
- Thermonuclear conversions on the Sun (e.g. solar energy, energies of biological origin, wind energy etc.).

Analyzing historical data, coal has certainly enabled the beginning of industrial era, oil revolutionized transport, while nuclear energy enabled further development and raised numerous questions. Today, however, when the use of energy has reached such a level that it is estimated that the supply of fossil fuels will soon be exhausted, renewable energy sources increasingly gain importance¹⁷. Trends in European energy policy are moving in the direction of increasing the share of renewable energy sources and reducing consumption in all sectors. Fundamental document determining the policy of the European Union towards renewable energy sources is the White Paper on Renewable Sources which indicates that, despite significant potential, renewable energy sources are insufficiently utilized and that it is necessary to find the most efficient measures in order to increase their current share in the total energy consumption from cca 6% to 12% by 2010. Every member state in this sense adopts its own strategy, within which it proposes its contribution to the overall objective and lists planned measures and action plans. In order to stimulate development and market penetration of renewable sources of energy projects, as the assurance of the coordinated implementation at EU level, the European Commission has

proposed a special campaign for the promotion of renewable sources which defines individual goals for the application of individual technologies:

- 1 000 000 photovoltaic systems
- 10 000 MW wind power plants
- 10 000 MWt biomass plants
- Integration of renewable energy sources in the local communities
- 5 000 000 tons of liquid biofuels.

Renewable energy sources and the Republic of Croatia

Energy Development Strategy of the Republic of Croatia has set the following strategic goals for the use of renewable energy sources by 2020²²:

- Increase in the share of renewable sources in direct energy consumption by 20%
- Increase in the share of electrical energy production from renewable energy sources (including large hydroelectric power plants) in the total electrical energy production by 35%
- Increase in the share of biofuels in the consumption of petrol and biofuels in transport by 10%.

Republic of Croatia has good natural opportunities to exploit renewable energy sources. The advantages of using renewable energy sources in European cities have long been known and Croatia, as EU candidate, uses the capital of pre-accession funds and thus finances several projects in the field of energy sector, financed by the IPA pre-accession fund for the period from 2007 to 2013. The CIP program is also currently available to Croatia, whose subprogram IEE (Intelligent Energy in Europe) is intended for technological activities in the energy sector and stimulating actions on renewable energy and improving energy efficiency²⁴.

Target share of the electrical energy production from renewable energy sources in the total production for the Republic of Croatia by 2020 amounts to 35% including large hydroelectric power plants according to the draft of the Green Paper: Adaptation and Upgrade of the Energy Development Strategy of the Republic of Croatia. The largest part of the abovementioned production will certainly be achieved from large hydroelectric power plants.

Renewable energy sources in the Republic of Croatia are used for the production of thermal and electrical energy. Water energy is mostly used for the production of electricity, while little use is made of other sources, especially the solar energy and biomass¹⁷. Figure 3 shows the share of individual renewable energy sources in the total electrical energy production in the Republic of Croatia in 2010.

Biomass is the most widely used renewable energy source in the total production of thermal energy in the Republic of Croatia in 2010, while exceptionally little use is made of solar and geothermal energy¹⁷. Figure 4 shows the shares of biomass, solar energy and in the total thermal energy production in the Republic of Croatia in 2010.

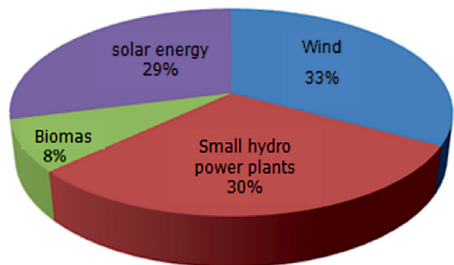


Fig. 3. Share of individual renewable energy sources in the total electrical energy production in the Republic of Croatia in 2010²².

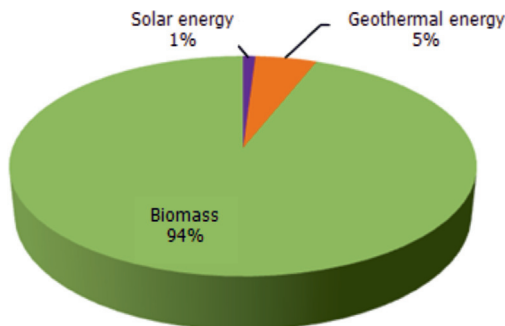


Fig. 4. Share of individual renewable energy sources in the total thermal energy production in the Republic of Croatia in 2010²².

Recently, there has been an evident increase in the interest of investors in this sector. Although the energy from renewable sources, excluding large, contributes to the total energy balance in a small percentage, according to the number of projects submitted to the Register of renewable sources' projects, an annual increase in production capacities and their market penetration are evident. Further increase in the energy from renewable sources in the total energy balance is expected, especially electrical energy from wind power plants¹⁷.

Renewable sources of energy in the Republic of Croatia, if we take into consideration the production of energy from large hydro power plants, participate in the total consumption in the amount of 24 percent. This fact ranks Croatia, compared to the EU average (EU-27) of 11.7 percent share of using renewable energy sources in direct energy consumption, among the most successful in the EU²⁵. The share of renewable energy sources in the total energy consumption in Croatia amounted to approximately 24 percent in 2010. The total production of electricity in 2010 amounted to 14 105 GWh, whereby renewable energy sources, including large hydro power plants, produced approximately 61 percent. Large hydro power plants participated with 58.9 percent in this percentage, while 2.1 percent of electrical energy was produced from other renewable sources (small hydro power plants, wind energy, biomass, landfill and biogas). Electrical energy produced from renewable energy sources participated with 45.6 percent in the total consumption. In this, electrical energy produced in large hydro power plants achieved a share of 44 percent, while electrical energy produced from other renewable energy sources participated with 1.6 percent²².

Discussion

Ensuring the sustainability of energy system through the use of renewable energy sources

Conflicts over resources, growing world demand for energy, climate changes and Fukushima disaster show that our energy supply system needs change. In the long run, a sustainable energy policy protecting resources and climate is necessary, which also abandons nuclear energy and turns to renewable sources²⁶.

It is possible to base a successful overall local and regional development on the development and increase in the use of renewable energy sources, as shown by numerous examples in developed countries, based on whose experiences numerous benefits of using renewable energy sources are recognized²⁴. Across the European Union grows the number of examples of small communities which managed to achieve total energy independence by producing energy sufficient for their needs. Feldheim village in Germany bases its independence on 43 wind turbines with a total power of 4.3 MW, what is much more than the community itself needs. Likewise, they have built biogas plants where electrical energy is produced from biomass²⁷. Freiamt village produces more energy than is needed using wind turbines, photovoltaic systems and biogas plants. The town of Freiburg and Wildpoldsried village, likewise located in Germany, achieved energy independence by using identical elements as the previous two villages. The number of examples of energy independent settlements in Europe grows: Varese in Italy, the Thisted province in Denmark, the island of Samsø in Denmark, the town of Kristianstad in Sweden, as well as the city of Reykjavik on Iceland¹⁷.

The Republic of Croatia has good natural opportunities for the exploitation of renewable energy sources. The benefits of using renewable energy sources in European cities have long been known and Croatia as an EU candidate uses the capital from pre-accession funds and thus finances several projects in the field of energy sector, financed by the pre-accession fund IPA for the period of 2007 to 2013. The CIP program is also currently available to Croatia, whose subprogram IEE (Intelligent Energy in Europe) is intended for technological activities in the field of energy and stimulating actions on the subject of renewable energy and the improvement of energy efficiency²⁴.

Renewable energy sources are an important part of the concept of sustainable development, beside energy efficiency representing the main basis of energy security and sustainable energy industry. The use of renewable energy sources has numerous advantages, one of them being increased security of supply and reduced dependence on the imports of oil, gas and other energy sources, as well as resistance to price changes on international energy markets. Furthermore, the advantage of using renewable energy sources is the creation of new jobs, or the possibility of local employment of Croatian population, and thus the possibility of economic recovery through the development of green economy. The use of renewable energy sources would also contribute to a cleaner environment and reduced greenhouse gas emissions. The use

of renewable energy sources can significantly increase energy security and energy independence of Croatia, therefore, in order to avoid dependence on one single source of energy, regarding sustainability and long-term stable energy policy, it is necessary to particularly develop renewable energy sources²⁸. According to estimates, Croatia will in 2030 use 70% of imported energy, what is a strong incentive for a greater use of renewable energy sources. Reduction of dependence on imported energy can be achieved by using one's own natural resources and potentials through the development of technologies which will use renewable energy sources. By investing in renewable energy sources, the Republic of Croatia will have a reliable and sustainable energy sector, whose development will be based on the exploitation of all energy options for the fulfillment of its own energy needs¹⁹.

Conclusion

Fossil fuels are modern civilization's primary source of energy. They led to social growth and development, to

the improvement in the quality of life, but at the same time to a very high dependence on them. Today, energy geopolitics has become one of crucial factors for the political power of countries which possess oil compared to those which do not. The current system of energy supply from fossil sources is functional at the moment but is not sustainable in the long run. World demand for oil is growing and sources are limited. By reducing dependence on the use of fossil fuels and energy imports, the security of energy supply increases and thus new chances for the economy, entrepreneurship, industrial competitiveness and development of green economy are created, with a positive impact on regional development and employment. By increasing the use of renewable energy sources and energy efficiency, we reduce the impact on the environment on all levels, which is in compliance with the global strategy of sustainable development. Energy security and simultaneous mitigation of climate changes should be a priority of every country's energy policy and a significant dimension of long-term goals of sustainable development.

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ENERGETSKA SIGURNOST I OBNOVLJIVI IZVORI ENERGIJE

S A Ž E T A K

Opskrba energijom od vitalnog je značenja za funkcioniranje zajednice te predstavlja važnu sastavnicu kako nacionalne, tako i međunarodne sigurnosti. Sigurnost opskrbe energijom i zaštita energetske infrastrukture dio je koncepta zaštite sveukupne kritične infrastrukture te predstavlja jedan od ključnih preduvjeta za razvoj svake zajednice. Energetska sigurnost ugrožena je zbog činjenice da su svjetske rezerve nafte i prirodnog plina nejednoliko raspoređene, a nesiguran transport preko trećih zemalja dodatno ugrožava sigurnost opskrbe energijom. Pitanje, ne samo sigurnosti nego i mogućnosti opskrbe energijom je zasigurno i ograničenost obnovljivih izvora energije, stoga će se u radu razmatrati mogućnosti kontinuiranog osiguranja energije u vidu razvoja obnovljivih izvora energije.