

Socio-Economic Conditions of the Construction of the Self-Sufficient Energy Regions in the Countries of Central and Eastern Europe (CEECs)

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Abstract—The conception of the construction of Self-Sufficient Energy Regions is a new innovative proposition to build self-sufficient, in terms of energy, regions in highly developed countries. The idea of developing Self-Sufficient Energy Regions is to assure energy security and the exploitation of local resources for the construction of an energy mix, which is entirely in line with the socio-economic conditions for the development a given area. Implementing the conception changes the socio-economic structure and creates new chances for the socio-economic development with the observance of sustainable development principles. Considering the role and importance of energy for the development of economies and societies, in order to ensure competitiveness of the CEECs it becomes necessary to commence works on the development of innovative energy conceptions, including the construction of Self-Sufficient Energy Regions. The purpose of this paper is to present the conception of the construction of Self-Sufficient Energy Regions and to conduct a feasibility study regarding the development of such regions in the CEECs.

Index Terms—Energy, renewable energy, self-sufficient energy region.

I. INTRODUCTION

The energy sector can be defined and construed in two ways. On one hand, we can consider its functioning in a broad sense and scope. In this aspect, an energy sector is construed as all processes related to the acquisition of energy sources, generating and processing of the same and supplying it to the final users. In the case of narrower context, an energy sector can be analysed in the aspect of energy production and supply to its users. Functioning of the energy sector also determines a broadly construed energy security of particular economies.

The dynamic changes, which take place in the political, economic and social sphere, as well as in the sphere related to the protection of natural environment, force the necessity to make strategic decisions and actions towards rationalisation of energy sectors of particular countries or regions. The policy relating to energy resources and their optimal exploitation should seek for more and more common construction of local energy systems, which are based on local and regional natural, human and capital resources. Considering the role and importance of energy for the development of economies and societies, in order to ensure competitiveness of the CEECs. (CEECs is an OECD term for

the group of countries comprising Albania, Bulgaria, Croatia, the Czech Republic, Hungary, Poland, Romania, the Slovak Republic, Slovenia, Estonia, Latvia and Lithuania) it becomes necessary to commence works on the development of innovative energy conceptions, including the construction of Self-Sufficient Energy Regions. The purpose of this paper is to present the conception of the construction Self-Sufficient Energy Regions and to conduct a feasibility study regarding the development of such regions in the CEECs.

II. SOCIO-ECONOMIC CONDITIONS FOR THE DEVELOPMENT OF ENERGY INDUSTRY IN THE CEECs

Analysing the conditions for the development of the countries of the CEECs, on one hand one should take into account significant similarities (which undoubtedly include historical conditions or developmental ambitions) [1], whilst on the other hand the differences (cultural, religious, social, economic or environmental). Undoubtedly, a common starting point that connects all countries is the process of integration with the European Union (EU), which in case of all the countries in question (except Albania) was finalised by full membership in the community. Seeking for integration with the EU [2] forced the acceptance of many regulations as regards the protection of natural environment [3], which unambiguously translated also into the CEECs' energy sector. Undoubtedly, an important factor which had an impact on the energy sector development in this part of Europe are historical conditions, including, to a large degree, great dependency on the supply of fossil fuels from the Russian Federation, which even after joining the EU, "... CEE member states remained subjected to the old rules of Russia's hardball energy politics" [4].

A common problem is bad technical condition of energy infrastructure which requires huge replacement investments, which certainly the countries from the group in question are unable to make. The existing infrastructural gap, not only in the energy sector but also in the transport, housing and public infrastructure, as well as in the health protection sector, etc. leads to a situation, wherein the CEECs need to choose directions for the allocation of available capital resources. This leads to a situation, in which the problems of energy industry and the whole energy sector very often are not taken as priority undertakings and projects within the scope of upgrading the energy sector and are put on ice. One of the main factors which prejudices of such an approach is the political aspect. One should bear in mind that all investments in energy sector are long-term investments, which is why they

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don't provide for the achievement of fast political effects. In addition, a huge problem of the CEECs is a disadvantageous energy mix (e.g. coal-based energy industry), which highly hinders any changes in energy sector and the compliance with international public commitments regarding the protection of natural environment.

In addition, a serious social problem is the lack of tendency among the society and enterprises to take pro-innovative actions, which naturally are burdened with higher risk level. Negative tendencies are intensified by the energy consumer's customs, which manifest themselves in the lack of habit to save both the energy and the natural resources. Another stigma to be faced by the analysed group of countries is relatively low level of knowledge and awareness of the society concerning the protection of natural environment. In addition to the said social problems, there exist economic problems resulting from far weaker economic condition and lower level of development of the CEECs as compared to the other EU member states. Table I presents statistical data on the CEECs as regards the energy intensity of the economy.

TABLE I: ENERGY INTENSITY OF THE ECONOMY (GROSS INLAND CONSUMPTION OF ENERGY DIVIDED BY GDP (KG OF OIL EQUIVALENT PER 1 000 EUR))

geo/time	2005	2015
EU (28 countries)	149.2	120.4
Bulgaria	614.0	448.5
Czech Republic	327.0	249.2
Estonia	373.9	358.0
Croatia	222.5	192.9
Latvia	252.3	206.7
Lithuania	329.5	205.4
Hungary	278.0	233.6
Poland	321.7	227.3
Romania	357.2	226.7
Slovenia	220.2	177.6
Slovakia	355.1	215.1
Albania	318.5	223.6

Sources: Own study based on EUROSTAT data

Particular CEE member states, regions and areas are highly diversified and disproportionate as regards the approach to economic transformation – and thus the approach to energy structure, access to raw materials, availability of energy infrastructure or the approach of communities and political class to energy-related problems [5]. As it follows from the analysis of the data from Table I, there are great disproportions in the economy's energy intensity of particular countries. The most effective is the economy of Slovenia and Croatia. Whereas the worst situation concerns the economy of Bulgaria, where energy intensity of the economy in 2015 was three times bigger as compared to countries characterised by the least energy intensity. Analysing the data concerning energy intensity of particular economies in the CEECs, it should be emphasised that in the years 2005-2015 there was a substantial improvement in all countries in respect of the factor in question.

Also, in the case of the share of renewable energy sources in energy structure of particular countries, the situation is diversified. An unbeatable leader in this regard is Latvia, where the share of energy from renewable energy sources (RES) in 2015 was 37.6%. At this point it should be

emphasised that in many countries (Bulgaria, Czech Republic, Estonia, Croatia, Lithuania, Hungary and Romania), the target of the directive that was supposed to be achieved by the said countries until 2020 was exceeded in 2015. Poland was the country which in 2015 was characterised by the smallest percent of energy produced from RES (11.8%) (see Table II).

TABLE II: SHARE OF RENEWABLE ENERGY IN GROSS FINAL ENERGY CONSUMPTION (IN %)

geo/time	2005	2015	2020 target
EU (28 countries)	9.0	16.7	20
Bulgaria	9.4	18.2	16
Czech Republic	7.1	15.1	13
Estonia	17.5	28.6	25
Croatia	23.8	29.0	20
Latvia	32.3	37.6	40
Lithuania	16.8	25.8	23
Hungary	4.5	14.5	13
Poland	6.9	11.8	15
Romania	17.3	24.8	24
Slovenia	16.0	22.0	25
Slovakia	6.4	12.9	14
Albania	30.7	34.9	:

Sources: Own study based on EUROSTAT data

The discrepancies in energy industry structure, energy intensity of the economy or prices of energy in particular regions and consequently the local economies themselves, result from many factors, from among of which the most important ones are:

- geographical position and availability of natural resource,
- availability of energy, transport and housing infrastructure,
- human resources,
- availability of capital and access to aid schemes and supporting funds,
- interest in solutions using RES and its acceptance,
- innovativeness of the economy (enterprises) and availability of R + D potential,
- local, regional and national historical and political conditions.

To summarise the above deliberations, a serious question appears, whether the CEECs, considering the socio-economic problems, referred to above, can be – within the meaning of J. Sachs [6] - innovators or if they can only provide services in favour of innovations and possibly work in favour of certain innovations. Therefore, a question arises, whether the CEECs, considering the role of energy sector in the socio-economic development, could lead up to levelling of the standard of living, the level of innovativeness and economic development among them and the richest EU member states.

A certain pro-development chance, which in the CEECs still waits for its discovery and use, are the Self-Sufficient Energy Regions. Due to the conditions and political, social and economic ambitions of the CEECs, referred to in this article, it is important to consider the space of public obligations arising from the connections with the EU and its energy policy.

III. ENERGY POLICY OF THE EUROPEAN UNION

The basic condition of sustainable development is to

guarantee a high-quality standard of living to the present and future generations, with rational exploitation of available resources. This approach prevails in international economic relationships, and for the last years it has been focused on the need to transform the socio-economic systems towards the so-called green economy” [7]. One of the indicators that characterise sustainable development is energy self-sufficiency, defined by the relation of quantity of energy acquired to quantity of energy consumed in a given country/region. To this extent, the method and technology of energy acquisition and consumption become particularly important - especially the way it affects the natural environment.

The European Council spoke in detail about this matter, noting that „the energy policy of the European Union must ensure security of energy supply to households and enterprises for reasonable and competitive prices and costs, in a safe and balanced way. This is particularly important for competitiveness of Europe, considering growing demand for energy in the biggest economies and high prices and costs of energy” [8]. All EU member states and institutions are responsible for the shape of adopted and implemented energy policy. This is prejudged in Article 194 of the Treaty on the functioning of the EU, which implements a legal basis that regulates activities of the EU and the Member States in the field of energy. The European Commission presented a number of objectives for the member states, the achievement of which shall be necessary in order to implement the policy on energy [9]:

- providing a guarantee that Europe shall be supplied in electric energy,
- ensuring that energy prices shall not be a drag chain for competitiveness of Europe,
- the environmental protection, in particular preventing climate changes,
- developing power grids.

Simultaneously, it was noted that the member states were totally free to invest in the energy sources they chose, whereas they must consider the European targets related to energy effectiveness, renewable energy sources or atmospheric air pollution. In terms of tasks, the European political strategy that is currently implemented is based on the so-called Third Energy Package, which was adopted in 2009. The package targets were also included in the “Europe 2020” strategy and called the “20-20-20 program” [10]. As it stems from Directive 2009/28/WE, by 2020 the European Union as a whole should reach 20% share of energy from RES in the total energy consumption and 10% share of such energy in transport. The Directive sets also the national targets, mandatory for each member state (see Table I). The previous results of undertaken actions in this regard demonstrate that the EU has a chance to achieve its targets for year 2020 [11]. The future of energy policy of the European Union after year 2020 was defined in the so-called Energy Roadmap 2050 [12]. The document sets the framework for actions in energy sector. The main target set therein is continued reduction of greenhouse gas emission and actions aimed to increase the share of renewable energy in the energy balance of the EU, which are strictly connected with it.

The energy security strategy proposed by the European Commission [13] is also important for the shape of the EU policy on energy, which assumedly should constitute an integral part of the EU policy on energy until 2030. The purpose of the implementation of assumptions adopted in the document is to enhance resistance of the UE to energy crises, to diminish dependency on particular fuels and energy suppliers, and to increase the production of energy in Europe [14].

In order to implement the energy policy assumptions one may either take traditional actions or undertake innovative initiatives. Traditional actions include the diversification of energy supply and energy carriers, developing an internal energy market, upgrading the existing ones, searching for new energy acquisition technologies and lowering prices for the acquisition of energy. Whereas innovative actions are undertakings that drive at creative and innovative approach to energy consumption, its re-distribution, acquisition or transfer. Implementing the technologies directed to the environmental protection, the development of common energy market with areas outside the EU borders, educating and raising with the observance of the principles of saving energy sources, the environmental protection or the dissemination of information on the possibility to acquire energy sources and heat from RES can also be of major importance. An important role in this regard can be played by innovative organisational structures, allowing for the organisation of production, distribution and use in a new way based on distributed generation which uses local and regional renewable resources.

IV. SELF-SUFFICIENT ENERGY REGION CONCEPTION

A Self-Sufficient Energy Region is a part or whole region governed by local government units, which has its technical and organisational infrastructure that enables it to conduct self-reliant energy policy, in accordance with its own development strategy, subject to energy production basing on local resources in order to secure the demand for energy of all entities functioning within a Self-Sufficient Energy Region (from both public and private sector). Concurrently, the production of energy should be subject to the principle of sustainable development and should use the local resources (mainly RES).

Self-Sufficient Energy Regions develop dynamically especially in the highly developed countries [15], which for many years now have successfully developed innovative conceptions of energy systems. A case study shows that solutions adopted by particular energy regions have a positive impact and significantly contribute to the local socio-economic development [16]. The process of developing a Self-Sufficient Energy Region absolutely has to consist of the following stages:

- recognition and evaluation of the potential of different forms of energy on a given area,
- assessment of present and future energy needs of the area,
- assessment of real level of security of energy needs from the local sources,

- selection of supplementary energy supplier,
- preparation of local energy development plans,
- inventory and evaluation of technical condition of the local / regional energy infrastructure, the power network and collectors,
- undertaking an initiative to set up local enterprises engaged in the preparation and implementation of projects connected with the functioning of Self-Sufficient Energy Regions,
- promoting a Self-Sufficient Energy Region and the solutions applied in it,
- building a network of relationships between energy system entities in a Self-Sufficient Energy Region and between other Self-Sufficient Energy Regions.

The construction of a Self-Sufficient Energy Region is in principle directed to energy industry but to a large degree it has an impact on the socio-economic development of the whole area of impact (especially in the area of construction, transport or production (including agricultural production)). A Self-Sufficient Energy Region is also an innovative approach to organisational structure of a given region's energy system, directed to mutual network connections, not only in terms of capital but also in direct contacts between particular stakeholders.

Undertaking actions aimed to develop a Self-Sufficient Energy Region may consequently facilitate the creation of an area in which among others:

- the position of consumers will be strengthened and their energy needs will be better recognised,
- the local energy resources will be fully exploited,
- the road of distributing energy and different energy forms will be shortened (reduction of losses on energy transmission),
- the energy security will be increased,
- local and regional networks of relationships will be established, building the socio-economic potential of the region,
- the standard of living of inhabitants will be improved,
- enterprises will be more competitive,
- the natural environment will be improved,
- the role of the local government units as authorities acting as governors on a given territory will be enhanced,
- the finances of local government units will be subject to betterment,

The conception of the construction of Self-Sufficient Energy Regions in the CEEs should be considered in the following aspects:

- legal aspects (relating to i.a. rights connected with feasibility to produce, distribute and sell energy),
- political aspects (a change in energy paradigm leads to systemic changes not only in particular regions but across the whole country),
- economic aspects (developing a Self-Sufficient Energy Region requires considerable capital expenditure. It is necessary to provide instruments to support new energy investments within a Self-Sufficient Energy Region),
- social aspects (a Self-Sufficient Energy Region

requires new, pro-ecological, pro-social attitudes of citizens, according to which households will become a part of the system,

- technical aspects (i.a. new solutions regarding the production, distribution and consumption of energy),
- natural environment aspects (a Self-Sufficient Energy Region may have a significant impact on improvement of the natural environment, including atmospheric air).

In order to effectively build Self-Sufficient Energy Regions it is necessary to take active steps in many areas of socio-economic life. To this extent, the role of local government units becomes more and more important, as they have an opportunity to influence the local and regional development as part of their own public tasks, the purpose of which is the satisfaction of the local government community needs.

V. CONCLUSION

The CEECs, which have an obsolete energy infrastructure and little investment and technological potential, can now face new challenges within the scope of power engineering - mainly distributed power engineering - which enables the development of new organisational structures, including autonomous energy regions. The transformation in the energy sector takes place at a time, when the CEECs face the necessity to change the method of energy production and consumption. Simultaneously, it should be unambiguously stated that maintaining the existing structure and methods of acquiring and using energy for industrial and living purposes cannot be accepted. The necessity to take actions is forced not only by international public obligations assumed by the CEECs, but also by economic, social and environmental reasons.

It needs to be emphasised that the CEECs have huge potential in the development and construction of Self-Sufficient Energy Regions. The countries not only have many potential options to use renewable energy resources, but they are also countries in which agricultural sector plays an important role, where distributed generation, which has the biggest potential for the development of Self-Sufficient Energy Regions, prevails. Due to distributed character of energy installations of RES used in Self-Sufficient Energy Regions, in combination with relatively small implementation barriers and innovative conception, it gives a chance for particular regions of the CEECs to create their own unique innovative conception of local and regional development, which will make it possible to enter the path of dynamic socio-economic development based on local resources.

In the opinion of the authors, the main reasons why Self-Sufficient Energy Regions have not been developed yet in the group of countries in question is the lack of local leaders who would be able to take the political or financial risk related to the new initiatives. In addition, a significant problem is low awareness that investments in the energy sector need to be made urgently. It is also a common phenomenon that economic entities that could take the investment risk expect

high rates of return, basing the security of investment successfulness on one foundation – rates guaranteed for buying back the produced “green energy”, while the idea itself of Self-Sufficient Energy Regions is contrary. Benefits for the participation in the undertaking are savings which can be later re-invested in other areas of the economy, and thus contribute to the development of a territorial unit.

Undoubtedly a key to solve the problem is education and promotion of good practices, which can make certain local communities take the trouble to develop Self-Sufficient Energy Regions, and in consequence there will appear the followers who, taking advantage of their experience, will undertake similar initiatives in other regions of the CEECs.

Additionally, it must be noted that the lack of initiatives as regards the development of Self-Sufficient Energy Regions may contribute to a situation, in which many countries of the CEE will not be able to fulfil their public commitments within the scope of power engineering or environmental protection. They also expose themselves to the risk that the investments made in renewable energy industry will not be fully effective and rational, neither in economic nor in social terms.

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