

RENEWABLE ENERGY ALTERNATIVES IN CENTRAL AND EASTERN EUROPEAN COUNTRIES – THROUGH THE EXAMPLE OF HUNGARY

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Abstract

The European Union can be considered as the leader of the struggle for a new energy economy, in particular in the field of alternative energies and climate policy. The EU legislative and support framework for the promotion of the use of renewable energy has undergone significant development over the last few years. The feasibility and sustainability of the goals also lie in the productivity of the smaller territorial units and countries of the Union, thus, each country must find the development trends appropriate to their local circumstances, which must be materialized in sustainable investments. In the Central and Eastern European region (Hungary, Poland, the Czech Republic, Croatia, Slovakia, Slovenia), which has similar characteristics (historical, cultural, geographical regarding renewable energy forms), the renewable energy market is clearly underdeveloped compared to Western



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European countries. As a result, there are considerably more opportunities to develop green projects in the future. In our present examinations, we look at the directions of renewable energy development projects, which are already in process and are expected to accelerate in the future, through the example of Hungary.

Keywords: renewable energy market, East-Central Europe, Hungary, investments, green projects

Összefoglalás

Az Európai Unió megújuló energiaforrásokhoz kapcsolódó célkitűzéseinek teljesíthetősége és azok fenntarthatósága az Unió kisebb területi egységeinek, országainak teljesítőképességében is rejlik, így minden országnak meg kell találnia a helyi adottságaihoz illeszthető fejlesztési irányokat, melyeknek fenntartható beruházásokban kell testet ölteniük. Az Európai Unió több szempontból (történelmi, kulturális, földrajzi) hasonló adottságokkal rendelkező kelet-közép-európai térségének (Magyarország, Lengyelország, Csehország, Horvátország, Szlovákia, Szlovénia) megújulóenergia-piaca egyértelműen alulfejlett a nyugat-európai országokéhoz képest. Ebből adódóan lényegesen több lehetőség mutatkozik zöld projektek generálására a jövőben. Jelen vizsgálatainkban a már elindult, és a jövőben várhatóan felgyorsuló megújuló energia-ipari fejlesztések irányait tekintjük át Magyarország példáján keresztül. A témát felölelő vizsgálataink során a saját adatgyűjtéseken alapuló descriptív statisztikai módszerek mellett kvalitatív kutatás keretében 25 magyarországi szakértői/szakmai szervezeti véleményeket és tapasztalatokat feltáró strukturált mélyinterjú készült megújuló energiaforrások hasznosításának jelenére és jövőjére vonatkozóan, így tanulmányunkban az elmúlt időszakban felhalmozódott szakértői tapasztalatok, nézőpontok is megjelennek.

Kulcsszavak: megújuló energia-piac, Kelet-közép Európa, Magyarország, beruházások, zöld projektek

1. Introduction

1.1 Renewable Energy Objectives in the European Union

Following the enlargement of the EU in 2004, ambitious goals have been set for the EU-25. In March 2007, the European Council adopted the new EU Energy and Climate Package, which main objectives are sustainability, competitiveness and the security of supply. To implement the program, the EU has committed itself to increase the share of renewable energy sources to 20% in total energy consumption. Commitments should not be met at national levels, but at EU level on average, since the economic situation, the energy structure, the supply of resources and the energy consumption of the countries showed internationally significant differences. Directive 2009/28/EC on the promotion of energy from renewable energy sources sets a mandatory target for 2020 for all EU member states, which refers to the proportion of renewable energy sources within the final energy consumption.

In order to achieve this, the member states have adopted national action plans on renewable energy in 2010 and reported their national action plan on renewable energy sources to the European Commission. The targets of the national plans are between 10% (Malta) and 49% (Sweden). The European Commission regularly evaluates the progress achieved by the member states regarding the objectives of renewable energy by 2020 and has set even more ambitious targets².

² In June 2016, the European Parliament adopted an attitude to the Renewable Energy Report demanding the European Commission to come forward with a more ambitious package on climate and energy policies by 2030 that will raise the EU's renewable energy target to at least 30%, which is to be achieved through specific national targets.

According to the latest resources available at the time of the preparation of the present study (Eurostat, 2017), 13% of the energy used in the European Union in 2015 came from renewable energy sources, compared with 8.5% recorded in 2005, the starting year of data recording.

According to the statistics of Eurostat (2015), Croatia (joining the Union in 2013) has reached the target set for the country by 2020 in 2015, some other countries (Denmark, Lithuania, Italy) have a few percentage to complete the target. Almost all the other member states will have to make further efforts to reach the 2020 targets. However, it is important to emphasize that many other countries have set up very ambitious goals – depending on their economic development and other characteristics (Denmark 30%, Austria 34%, Finland 38%, Latvia 40%, Sweden 49%).

2. Material and Methods

Future uncertainties in energy supply, economic efficiency issues, climate protection efforts have also raised the value of renewable energy in the Central and Eastern European region. In our study we will review the results regarding the realization of the EU commitments so far for the Central and Eastern European countries (Hungary, Poland, the Czech Republic, Croatia, Slovakia, Slovenia). The present essay is a 'snapshot' which gives a picture of the results of the recent period and shows the realization of EU development concepts and targets through the example of Hungary. We supplemented the data provided by the European Union and the member states with the available data provided by international and national renewable energy organisations, associations, statistics and own data collection. In this part of the research, we used mostly simple, descriptive statistical methods, such as distribution ratios, quantification of proportion changes and descriptive analysis of certain time series (Barna-Molnár 2004, Molnár 2015). In addition, in the framework of qualitative

research, structured in-depth interviews with 25 Hungarian experts/professional organizations were made exploring their opinions and experiences on the present and future of the utilization of renewable energy sources. The sampling process was conducted using 'snowball' method (based on expert recommendation), the survey was carried out between September 2017 and January 2018. In the present essay, the partial results of this exploratory research – as well as the accumulated expert experiences and perspectives – are published.

The global development of the renewable energy industry creates opportunities for the transformation of the national economy, the comprehensive production and market reforms, the production of marketable goods, job creation and job restructuring in the Central and Eastern European region – thus, also in Hungary –, which has similar characteristics in several aspects (historical, cultural, geographical regarding renewable energy forms). The results of our research, the conclusions on this topic can help regions with similar characteristics in investment decisions, in the development of a suitable renewable energy mix. The research was supported by the ÚNKP-17-4 New National Excellence Program of the Ministry of Human Capacities.

3. Results

3.1 Renewable Energy Sources in Central and Eastern European Countries

In the examined Central and Eastern European region, energy saving and the increase in the utilization rate of renewable energy sources are on the agenda not only due to the requirement to achieve the related EU objectives, but due to the fact that it also may decrease energy import significantly, which can bring environmental aspects to the fore. A significant part of the buildings in the region is outdated regarding energy efficiency, they waste energy. Recent targeted EU and national tender opportunities have contributed to energy efficiency

improvements and the inclusion of renewable energy sources into energy systems significantly.

Table 1 shows the ratio of renewable energy and the distribution of renewable energy sources by categories in the wider region. The 2020 target ratio for renewable energy in the region is between 13.5% (the Czech Republic) and 25% (Slovenia). The commitments of Croatia (20%) and Slovenia (25%) are forward-looking, while those of the other countries are more modest, depending on their economic indicators and strategic objectives, between 13.5 and 15.5 %. Hungary (14.65%) is in the middle, ahead of the commitments of Slovakia and the Czech Republic.

Table 1: The typical values of the ratio of renewable energy and the distribution of renewable energy sources by categories in the countries surveyed in 2015

Denomination		Hungary	Poland	Czech Republic	Croatia	Slovakia	Slovenia
Share of renewable energy in 2005 (%)		4,3	7,2	6,1	12,8	6,7	16,0
Share of renewable energy in 2015 (%)		12,0	9,4	10,1	23,0	9,6	16,1
Target of share of renewable energy till 2020 (%)		14,65	15,5	13,5	20,0	14	25,0
Proportion of renewable energy by categories (2015, %)	Solar energy	1	1	5	1	3	3
	Biomass and waste	93	87	90	67	75	61
	Geothermal energy	3	0	0	0	0	4
	Hydropower	1	2	4	28	21	31
	Wind energy	2	11	1	3	0	0

Source: Own editing based on datas from REN21 (2016) and Eurostat Statistics Explained (2017)

It can be concluded that the progress of member states in the survey is partial and extremely uneven. Within the utilization of renewable energy, solid biomass has a predominant role in some countries (Hungary, Poland, the Czech Republic), while in others – due to their geographic features – water resources are the most important (Croatia, Slovakia, Slovenia). There are several reasons for the difficulties encountered in advancing further renewable energy forms. The higher costs of renewable energies seemed unaffordable to the

population from the viewpoint of their income and also to the corporate sector that has emerged from the crises and transformation processes of the last decades. Inadequate, in some cases insufficient information, administrative problems, difficult licensing and commissioning procedures, as well as the long-term unpredictability of the delivery prices of small- and medium-sized power plants using renewable energy sources did not favour the spread of these solutions.

3.2 Renewable Energy Alternatives in Central and Eastern European countries – through the example of Hungary

In the current global industrial environment, the mining of fossil fuels is unprofitable in many cases in Hungary. Regarding the composition of primary energy production, the yield of natural gas, oil and coal has almost halved over the past fifteen years. Nowadays, one third of the resources to cover energy needs comes from domestic production and two thirds from imports.

Before the millennium, electricity supply was based on fossil and nuclear power plants almost exclusively, today renewable energy sources have also been involved, but most of the Hungarian production (40%) is the electricity from nuclear power³.

The ratio of energy from renewable sources within the consumption is rising steadily, in 2015 it was 12%, approaching the EU average of 13% (Eurostat, 2017). The proportion of electricity produced from renewable sources was 7.3% in 2015. Looking at the data of the last ten years, it is clear that the increase in the ratio of renewable electricity stopped in 2011, then it started to grow again in 2013. A change in the legal environment of mixed combustion

³ The expansion of the Paks Nuclear Power Plant, signed on 14 January 2014, includes the construction of two new nuclear power plant blocks in Paks. The new nuclear power plant blocks will be constructed next to the four 500MW nuclear power plant reactors set up in Paks in 1982. As a result of the life-enhancing investment, which is a decisive element of the energy mix in Hungary, the capacity of the nuclear power plant will increase by 20% in the long run. (<http://www.atomeromu.hu/teljesitmenynoveles>, 2016)

power plants, and hence the fluctuations in biomass-based production play a role in this process. After a few years of stagnation, the renewable ratio of transport has also increased, it was between 6-7% in the last five years. The heating and cooling renewable ratio is around 20%. The increase in the ratio of renewable energy in recent years is due to the increase in the use of renewable energy and the decreasing gross final energy consumption (MEKH, 2017; Németh, 2017)

The expansion of usage of renewable energy sources in Hungary is hindered by a number of economic and social factors also (Varjú, 2013). The number and total performance of the renewable investments actually realized is steadily increasing, but there are definitely bigger opportunities than the current utilization. The commitments of the European Union and the EU funding opportunities for 2014-2020 also urge answering questions in the area and creating a more favorable and transparent situation.

3.2.1 Renewable Energy Market Situation Report – Solar Energy

Within the ratio of renewable energy, the utilization of solar energy was the most common in the Czech Republic (5%), Slovakia (3%) and Slovenia (3%) in the examined region in 2015. In Hungary, Croatia and Poland the ratio is around 1%. Despite the small ratio of solar energy, the region has been experiencing steady growth over the past ten years. This situation is due to the economies of scale of the solar cell market (retail prices have fallen considerably), the spread of incentive support schemes and the presence of more environmentally-conscious consumers. The latter are mainly from the younger generations and the wealthier older generation. The increase in solar panel systems is continuous, since their purchase and operation are relatively cheap, the payback period is short, maintenance is minimal and the scope of application is wide-ranging.

In recent years, the number of small-scale household power plants and their total installed capacity has also risen significantly in Hungary (Table 2). The positive trend experienced for several years continued in 2016, the installed capacity is doubled every year in this category.

Table 2: The amount and capacity of installed small-scale solar panel systems annually

SMALL-SCALE PHOTOVOLTAIC SYSTEMS	YEAR								
	2008	2009	2010	2011	2012	2013	2014	2015	2016
P < 50 kW number of household size small-scale photovoltaic systems (pieces)	107	165	292	629	1882	4855	8829	15131	20401
50 kW < P < 500 kW non-household size small-scale photovoltaic systems (pieces)	0	0	0	2	5	13	33	60	88
P < 500 KW Σ NUMBER OF SYSTEMS (pieces)	107	165	292	631	1887	4868	8862	15191	20489
P < 500 KW Σ CAPACITY kW	363	465	992	3 339	13 840	34 916	76 984	143 299	190 800

Source: own editing based on datas from Hungarian Energy and Public Utility Regulatory Authority (2017)

Half of the systems implemented so far are less than 5 kW, that is typically family houses. A quarter of them are between 5-10 kW, that is large consumer residential users or smaller municipal public institutions (eg. nursery schools, libraries, mayor's offices), and a further quarter between 10-50 kW, which covers the consumption of smaller plants, businesses and middle-sized commercial units. Licensed power plants of over 500 kW performance have also started their operation (Pécs, 10 MW, Visonta, 15, 6 MW) in the past one or two years.

It is important to note that the actual solar panel capacity is larger in Hungary than what is mentioned above, since these numbers do not include off-grid solar panel systems. We do not have detailed information about these systems.

The solar energy market was characterized by relatively steady growth from the beginning of the millenium to the end of 2008. According to the data of the Solar Energy Association of the Hungarian Building Engineers, a solar system of approximately ten thousand square meters has been realized by this year. Subsequently, growth has been fluctuating, the breakpoints in the growth rate coincide with the changes in the quality of support. The size of solar panel systems installed in Hungary until 2015 is 269,000 sq meters (Varga, 2017).

3.3 Renewable Energy Market Situation Report – Wind Energy

Regarding wind energy, Poland has the highest share (11%) within the ratio of renewable energy in the Central and Eastern European region in 2015. The majority of the energy produced this way comes from over twenty large wind power plants in the northern part of the country.

Croatia and Hungary reached 3% and 2% ratio by 2015. Further investments have been announced in the former country, in Hungary no permission has been issued for a wind power plant since 2011. In the Czech Republic 1% is the ratio of wind power within renewable energy utilization. In Slovakia and Slovenia, the use of wind power is minimal, its ratio is not provable. In the future, in addition to the power plant size, efficient, manageable, automated low-powered wind turbines are expected to appear in the region as well.

In Hungary, the annual average wind speed is 2-4 m/s (10 meters above the surface). The Hungarian Energy Authority issued a license for 330 MW wind power capacity in 2006, this performance was installed in 2011 (Table 3). According to the National Renewable Energy Action Plan (2010), the Hungarian electricity network can control a power of approximately 740 MW. Due to the changing directions of winds, power plants independent from winds with

the same capacity should be ready to use in case of the stillness of air, and controllability should be improved.

Table 3: Wind power plants in Hungary in 2016

Place (pieces)	Number of towers (pieces)	Unit-power (kW)	Total power (kW)	Installation (year)
32	172	225-3000	329 325	2000-2011

Source: Own editing based on datas from Hungarian Wind Energy Corporation (2016)

There are currently 172 wind turbines in the country. The number of towers is 1-19 at each location. The performance of the equipment ranges from 225 kW to 3 MW.

3.4 Renewable Energy Market Situation Report – Water Energy

Due to its geographic location, Slovenia had the highest ratio within renewable energy in the region (31%), followed by Croatia (28%) and Slovakia (21%) in 2015. In these countries, the potentials have been well exploited in the utilization of water energy. New developments focus primarily on the application of small to medium turbines. The latter type of developments can be of importance in the future in the Czech Republic, Poland and Hungary.

In Hungary, the vast majority of hydroelectric water plants operate on three major rivers and their tributaries. There are 29 miniature-, small- and medium capacity power plants, the total capacity of which is 53.297 MW (Table 4).

Table 4: Water power utilization bases in Hungary in 2016

Categories by built-in capacity	Typical range of capacity							
below 500 kW power plants (23 pieces) Σ 4,617 MW								
Between 500 kW and 10 MW power plants (4 pieces) Σ 8,77 MW								
Between 10 MW and 30 MW power plants (2								

pieces) Σ 40,5MW								
Σ CAPACITY 53,297 MW	0-0,5 MW	0,5-1 MW	1-5 MW	5-10 MW	10-15 MW	15-20 MW	20-25 MW	25-30 MW

Source: own editing based on datas from Hungarian Energy and Public Utility Regulatory Authority and own collection

The total performance of the Tisza (12.5MW) and the Kisköre (28 MW) Hydroelectric Power Plants operating on Tisza provides more than two thirds of the power output. The Kenyeri Power Plant (1.5 MW), opened in 2009, was constructed after a 30-year break in hydropower plant construction, since the last hydroelectric power plant in Hungary was built in the 1980s.

In research and development, the primary goal is to reduce costs and increase efficiency. According to expert opinions, the revision of the current Hungarian practice in the utilization of hydropower is reasonable in parallel with the development of technologies.

3.5 Renewable Energy Market Situation Report – Biomass

Solid biomass has a significant, sometimes predominating role within renewable energy utilization. Its ratio was around 90% in Hungary, in Czech Republic and in Poland in 2015 while in Slovakia, Slovenia and Croatia 75% of renewable energy comes from bio energy. In addition to traditional wood-heating, modern biomass heating has appeared in both small-scale and power plant sizes in the region in the past 10-15 years. In addition to large-scale biomass utilization, the sustainable development, growth of forestry and forest-based industries have to be given a prominent goal in Central and Eastern Europe in the future. Besides the increase in the efficiency of traditional wood-heating, the spread of pellet and briquette-heating can also be observed.

Alongside biomass combustion, biogas plants are also present depending on the level of development and the concentration of agriculture – in a much smaller scale compared to Western European countries. In recent years, the biggest debate has been the environmentally-friendly nature and grounds of biofuels, which has led to a number of investments that have failed or been postponed for several years. In the future, it is expected that second-generation (utilizing by-products, timber) solutions will also gain ground.

Approximately 90% of the heat energy produced from renewable energy sources comes from solid biomass in Hungary. Half of the electricity produced from renewable energy sources comes from solid biomass, we currently utilize most of the potential quantity. Several places of utilization, power plants would intend to rely on a supplier base of straw or woody timber from short rotation plantations in the long run.

3.6 Renewable Energy Market Situation Report – Geothermal Energy

In most of the Central and Eastern European countries surveyed, geothermal-based district heating systems already operate. In Hungary and in the Pannon basin, which includes the region next to the Hungarian border, heat flow of 90–100 mW/m² is well above the average, which is accompanied by high geothermal gradient of 45°C/km on average (Hungarian Office for Mining and Geology - MBFH, 2012). Taking advantage of these factors, relating the utilization of geothermal energy a ratio of 4% in Slovenia and 3% in Hungary could be detected within renewable energy sources in 2015. The geothermal potentials in the region would enable further district heating projects to be realized in other countries as well (e.g. Poland, Slovakia).

There is no geothermal-based electricity generation in the examined region. The development rate of near-surface heat pump energy utilization is much slower in the region than in the western and northwestern countries.

In Hungary, geothermal energy has been utilized on more than twenty sites for several decades (Table 5). About two thirds of it is used in district heating systems, while one third of it is used in individual heating systems.

Table 5: Deep geothermal heat energy utilization in Hungary in 2015

Place*	Year of implementation	Total capacity	Total annual energy production in 2014	Typical utilization mode
pieces	year	MW _t	GWh	-
23	1958-2015	219,08	827,59	Settlement, institutional energy supply, agricultural utilization

*The place is not equal to the number of wells. The number of wells is between 1 and 32 pieces per location.
Source: Own editing based on datas of the European Geothermal Energy Council (2014, 2016) and own collections

Near-surface energy utilization using heat pumps has been known to the public since the 2000s. Today, only a few thousand households generate energy with heat pumps.

4. Discussion

An important new industry and breaking technology is emerging around the world in connection with renewable energy sources. This development will not and should not keep away from the countries with less economic strength in the Central and Eastern European region. The present essay is a 'snapshot' which gives a picture of the results in the region in the recent period and shows the possible directions and opportunities of development through the example of Hungary.

Renewable energy utilization in the region is predominant in the form of biomass utilization. This is well-illustrated by the example of Hungary, where other renewable energy utilization methods have a much smaller role. As regional and Hungarian analyses show the development is indisputable, but its scale raises the need for further exploration, analysis and intervention in some cases.

The biggest advancement in the residential sector is in solar energy utilization, which is in line with global and Western European trends, it is on a smaller scale compared to the latter, but it already shows measurable progress. There is also progress in the field of heat pump investments and biomass combustion. The latter – in addition to the emergence of wood combustion in power plants and the increase in the efficiency of traditional wood heating – is slightly due to the spread of pellet- and briquette-heating.

Recently, most of the higher volume investments in the region have been realized with the involvement of tender sources. The number of self-financed investments is far less. Several renewable energy investment companies are seeking to make use of increased market interest in the stock market in the form of equity and bond issues. In the future, this may also be an increasingly popular investment form for small investors. In addition to favorable natural conditions, investments will be located in regions with favorable incentive systems and predictable energy policies, where investors are sure that the favorable support system for renewable energy will be stable and predictable. In many cases, the termination of the administrative and financial constraints that are currently delaying the realization of investments may be a major challenge.

With many similarities in the Central and Eastern European region, barriers that prevent consumers from being more energy-conscious and renewable energy sources from being more widespread have been known for decades, however, they remain until today and the practical

application is not popular with the people. In addition to low incomes, old habits, the lack of information and the simplicity of good practices, the 'fear' from the new all hinder the wider spread. There have been a number of attempts – mainly linked to tenders – to form and develop energy- and environment-conscious approach in the region, but the actual possibilities in this regard are – in our opinion – unexploited for the time being.

In the countries of the region – in line with the commitments of the European Union – an important national strategy objective is to achieve the highest degree of energy independence, as well as to find environmentally-friendly, economically and socially sustainable solutions, therefore the role of renewable energy is even more crucial.

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